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the mystic west

Writing in the British journal, *New Scientist,* the famed poet and historian Robert Graves recently said: "Technology is now warring openly against the crafts, and science covertly against poetry."

What Graves seems to be saying is that technology is allowing machines to replace human muscle power and handiwork—a discovery that the Luddites made nearly two centuries ago. What he doesn't say, but apparently fears, is the possibility that machines, such as electronic computers, might replace human brain power.

Graves's fears about technology are bad enough. Unfounded, maybe, but what the hell. 'Tis the season for pointing quavering fingers at technology and science. His attack on science itself is on a more mystical level, and seems even more unfounded. He contrasts science with poetry, and claims that poetry has a power that scientists can't recognize, "because, at its most intense—poetry—works in the Fifth Dimension, independent of time."

He goes on to say that poetry is usually the product of intuitive thinking, and grants that some mathematical theories have also sprung from intuition. Then he says, "Yet scientists would dismiss a similar process . . . as 'illogical'."

Apparently Graves sees scientists as a sober, plodding phalanx of soulless thinking machines, doing everything rationally, never making a step that hasn't been carefully scouted out in advance. He should try working with a few, or even reading "The Double Helix."

As a historian, Graves ought to be aware that James Clerk Maxwell's brilliant insight about electromagnetism—the guess that visible light is only one small slice of the huge spectrum of electromagnetic energy—was an intuitive leap into the unknown. Maxwell had precious little real evidence to back his guess. It wasn't until Hertz produced radio waves and Roentgen stumbled onto X rays that Maxwell's theoretical predictions were verified. Max Planck's original concept of the quantum theory was also mainly intuition. And the list of wild jumps of intuition made by these supposedly stolid, humorless scientists is long indeed.

It turns out that scientists are just as human, just as intuitive, just as emotional as any of us. But most people don't realize this. *They don't*

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know scientists, any more than they know science.

As C. P. Snow pointed out decades ago, there is a gap between the Two Cultures, and Graves shows a particularly painful chasm. Graves is a scholar who is widely and justly renowned for his work in ancient mythology, where he's combined his gifts of poetry and historical research in a truly beautiful way.

But he doesn't seem to know scientists, the men and women who do science. That's just as bad—worse, maybe—as not caring to know anything about science itself. And a person who doesn't understand science is simply not well-educated. Not in today's world.

Graves's attack on science gets particularly virulent when he says: "The worst that one can say about modern science is that it lacks a unified conscience, or at least it has been forced to accept the power of Mammon. Mammon . . . exploits the discoveries of science for the benefit of the international financiers, enabling them . . . to control all markets and governments everywhere."

He ends by saying, "There need have been no war between Science and Poetry, nor between Technology and the Arts, had not the power of money forced too many poor, married scientists and technologists to break what should have been a Hippocratic oath to use their skills only for the benefit of mankind."

That's a serious charge, made all the more serious by Graves's undoubted stature as a scholar. It points out problems that go far beyond the work of the scientists themselves. What significant group of people in the world today has "a unified conscience?" Do "international financiers" really control most national governments? How can scientists—or poets, or plumbers—determine what is "the benefit of mankind?"

It's significant that Graves ends up by attacking not science itself, but the *uses* to which science is put: the interface between scientific research and political policies, between the laboratory and the market place.

If this is where the problem is, why blame only the scientist? What part of the responsibility belongs to the politician and industrialist? To the taxpayer and the poet? After all, all that a scientist wants to do—as a scientist—is the research that inter-

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ests him. But the world isn't that kind to anyone. A scientist can only get to do the research that somebody will pay for.

Since the earliest flickerings of scientific curiosity, more than a hundred centuries ago, the scientist had to justify his existence. Why should a king support someone who does no useful work? The farmers produce food, the soldiers protect the kingdom or enlarge it, the tax-gatherers . . . well, everybody knows what they do. Why support a stargazer?

It turned out that the stargazers had some practical help to give. They could make calendars and predict the seasons—a very important trick in an agricultural society. And since they showed that the patterns of the stars affected events here on Earth, such as seasons, it was only a short step to astrology—predicting the affairs of individual people by the positions of the stars.

Astrology became a rooted part of astronomy for many long centuries. Galileo and Kepler cast horoscopes. Kings and emperors kept astronomers about them for their astrological predictions, not their studies of the universe. The *astronomical* went on, but only because the astrological forecasts were in demand.

Even today, the scientist still must pay his "astrological" dues to his patron. They're no longer casting horoscopes but their patrons still exact the same kind of payment. For example, a physics student looking for a research position in almost any nation on Earth has a much easier time finding funds if he works on a defense-related project.

Major astronomical installations have been built *first* because they could help the military watch potential enemies better, and only secondly because they might be useful in unraveling the mysteries of the universe. Chemists and biologists, for many years, found it easier to get funding in chemical and biological warfare programs than in public health research.

If it's the fault of the scientists for letting themselves be used in this way, it's equally the fault of the tax-paying public for insisting on strong military defense programs. Vietnam has drastically changed the mood of most Americans toward the military. But hardly anyone really wants us to disarm completely. And at this point in history, scientific research is a vital part of military power.

There's an old poolroom saying, "Put your money where your mouth is." Despite the loud noises being made in Washington and elsewhere about beating swords into plowshares and using our scientific and technological know-how to solve "the problems of the people," we are still spending more on military research and development than on all other forms of government-sponsored R&D. The Pentagon's R&D budget is about eight billion dollars. That's just about as much as all the other government agencies—from

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Health to NASA – have *in total.*

A scientist who wants to do research in his chosen field will almost inevitably be drawn into a defense-related program, unless his field is completely outside the Pentagon's areas of interest. You can't do research on promises, or political speeches. You need equipment and assistants. You need money. The Pentagon gets the money and calls the tune. If the tune is to be changed, it *can't* be by the scientists alone. It must be by the taxpayers, who have the power to decide where their research money should be spent.

Which brings us back to the crux of the problem: the average man doesn't know the scientists.

Since the prehistoric days of tribal shamans, most people have held an ambivalent attitude toward the medicine man-astrologer-wizard-scientist. On the one hand they envied his abilities and sought to use his power for their own gain. On the other hand, they feared his power, hated his seeming superiority and knew damn well that he was in league with the dark forces of evil.

There's been very little change in that double-edged attitude over the centuries. Today we still tend to hold the scientists in awe. After all, they're the ones who brought us nuclear power, modern medicines, space flight, and underarm deodorants. Yet at the same time we also see scientists derided as fuzzy-

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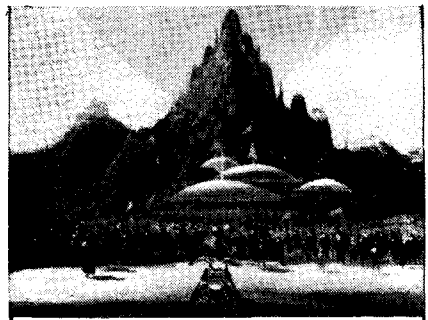

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With a highly-advanced technology, you'd hardly expect warfare to be anything but push-button automation, right? Wrong! The infantry is still the Queen of Battle, even out among the stars.

JOE W. HALDEMAN

Illustrated by Kelly Freas

I

"Tonight we're going to show you eight silent ways to kill a man." The guy who said that was a sergeant who didn't look five years older than I. Ergo, as they say, he couldn't possibly ever have killed a man, not in combat, silently or otherwise.

I already knew eighty ways to kill people, though most of them were pretty noisy. I sat up straight in my chair and assumed a look of polite attention and fell asleep with my eyes open. So did most everybody else. We'd learned that they never schedule anything important for these after-chop classes.

The projector woke me up and I sat through a short movie showing the "eight silent ways." Some of the actors must have been brainwipes, since they were actually killed.

After the movie a girl in the front row raised her hand. The sergeant nodded at her and she rose to parade rest. Not bad looking, but kind of chunky about the neck and shoulders. Everybody gets that way after carrying a heavy pack around for a couple of months.

"Sir"—we had to call sergeants "sir" until graduation—"most of those methods, really, they looked . . . kind of silly."

"For instance?"

"Like killing a man with a blow to the kidneys, from an entrenching tool. I mean, when would you *actually* just have an entrenching tool, and no gun or knife? And why not just bash him over the head with it?"

"He might have a helmet on," he said reasonably.

"Besides, Taurans probably don't even *have* kidneys!"

He shrugged. "Probably they don't." This was 1997, and we'd never seen a Tauran; hadn't even found any pieces of Taurans bigger than a scorched chromosome. "But their body chemistry is similar to ours, and we have to assume they're similarly complex creatures. They *must* have weaknesses, vulnerable spots. You have to find out where they are.

"That's the important thing." He stabbed a finger at the screen. That's why those eight convicts got caulked

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for your benefit . . . you've got to find out how to kill Taurans, and be able to do it whether you have a megawatt laser or just an emery board."

She sat back down, not looking too convinced.

"Any more questions?" Nobody raised a hand.

"OK.—tench-hut!" We staggered upright and he looked at us expectantly.

"Screw you, sir," came the tired chorus.

"Louder!"

"SCREW YOU, SIR!"

One of the army's less-inspired morale devices.

"That's better. Don't forget, predawn maneuvers tomorrow. Chop at 0330, first formation, 0400. Anybody sacked after 0340 gets one stripe. Dismissed."

I zipped up my coverall and went across the snow to the lounge for a cup of soya and a joint. I'd always been able to get by on five or six hours of sleep, and this was the only time I could be by myself, out of the army for a while. Looked at the newsfax for a few minutes. Another ship got caulked, out by Aldebaran sector. That was four years ago. They were mounting a reprisal fleet, but it'll take four years more for them to get out there. By then, the Taurans would have every portal planet sewed up tight.

Back at the billet, everybody else was sacked and the main lights were out. The whole company'd been dragging ever since we got back from the two-week lunar training. I dumped my clothes in the locker, checked the roster and found out I was in bunk 31. Damn it, right under the heater.

I slipped through the curtain as quietly as possible so as not to wake up my bunkmate. Couldn't see who it was, but I couldn't have cared less. I slipped under the blanket.

"You're late, Mandella," a voice yawned. It was Rogers.

"Sorry I woke you up," I whispered.

" 'Sallright." She snuggled over and clasped me spoon-fashion. She was warm and reasonably soft. I patted her hip in what I hoped was a brotherly fashion. "Night, Rogers."

"G'night, Stallion." She returned the gesture, a good deal more pointedly.

Why do you always get the tired ones when you're ready and the randy ones when you're tired? I bowed to the inevitable.

II

"Awright, let's get some *back* inta that! Stringer team! Move it up—move up!"

A warm front had come in about midnight and the snow had turned to sleet. The permaplast stringer weighed five hundred pounds and was a bitch to handle, even when it wasn't covered with ice. There were four of us, two at each end, carrying the plastic girder with frozen finger-

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tips. Rogers and I were partners.

"Steel!" the guy behind me yelled, meaning that he was losing his hold. It wasn't steel, but it was heavy enough to break your foot. Everybody let go and hopped away. It splashed slush and mud all over us.

"Damn it, Petrov," Rogers said, "why didn't you go out for Star Fleet, or maybe the Red Cross? This damn thing's not that damn heavy." Most of the girls were a little more circumspect in their speech.

"Awright, get a *move* on, stringers—Epoxy team! Dog 'em! Dog 'em!"

Our two epoxy people ran up, swinging their buckets. "Let's go, Mandella. I'm freezin'."

"Me, too," the girl said earnestly.

"One—two—heave!" We got the thing up again and staggered toward the bridge. It was about three-quarters completed. Looked as if the Second Platoon was going to beat us. I wouldn't give a damn, but the platoon that got their bridge built first got to fly home. Four miles of muck for the rest of us, and no rest before chop.

We got the stringer in place, dropped it with a clank, and fitted the static clamps that held it to the rise-beams. The female half of the epoxy team started slopping glue on it before we even had it secured. Her partner was waiting for the stringer on the other side. The floor team was waiting at the foot of the bridge, each one holding a piece of the light stressed permaplast over his head, like an umbrella. They were dry and clean. I wondered aloud what they had done to deserve it, and Rogers suggested a couple of colorful, but unlikely possibilities.

We were going back to stand by the next stringer when the Field First—he was named Dougelstein, but we called him "Awright"—blew a whistle and bellowed, "Awright, soldier boys and girls, ten minutes. Smoke 'em if you got 'em." He reached into his pocket and turned on the control that heated our coveralls.

Rogers and I sat down on our end of the stringer and I took out my weed box. I had lots of joints, but we weren't allowed to smoke them until after night-chop. The only tobacco I had was a cigarro butt about three inches long. I lit it on the side of the box; it wasn't too bad after the first couple of puffs. Rogers took a puff to be sociable, but made a face and gave it back.

"Were you in school when you got drafted?" she asked.

"Yeah. Just got a degree in Physics. Was going after a teacher's certificate."

She nodded soberly. "I was in Biology . . ."

"Figures." I ducked a handful of slush. "How far?"

"Six years, bachelor's and technical." She slid her boot along the ground, turning up a ridge of mud and slush the consistency of freezing ice milk. "Why the hell did this have to happen?"

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I shrugged. It didn't call for an answer, least of all the answer that the UNEF kept giving us. Intellectual and physical elite of the planet, going out to guard humanity against the Tauran menace. It was all just a big experiment. See whether we could goad the Taurans into ground action.

Awright blew the whistle two minutes early, as expected, but Rogers and I and the other two stringers got to sit for a minute while the epoxy and floor teams finished covering our stringer. It got cold fast, sitting there with our suits turned off, but we remained inactive, on principle.

I really didn't see the sense of us having to train in the cold. Typical army half-logic. Sure, it was going to be cold where we were going; but not ice-cold or snow-cold. Almost by definition, a portal planet remained within a degree or two of absolute zero all the time, since collapsars don't shine—and the first chill you felt would mean that you were a dead man.

Twelve years before, when I was ten years old, they had discovered the collapsar jump. Just fling an object at a collapsar with sufficient speed, and it pops out in some other part of the galaxy. It didn't take long to figure out the formula that predicted where it would come out: it just traveled along the same "line"—actually an Einsteinian geodesic—it would have followed if the collapsar hadn't been in the way—until it reaches another collapsar field, whereupon it reappears, repelled with the same speed it had approaching the original collapsar. Travel time between the two collapsars is exactly zero.

It made a lot of work for mathematical physicists, who had to redefine simultaneity, then tear down general relativity and build it back up again. And it made the politicians very happy, because now they could send a shipload of colonists to Fomalhaut for less than it once cost to put a brace of men on the Moon. There were a lot of people the politicians would just love to see on Fomalhaut, implementing a glorious adventure instead of stirring up trouble at home.

The ships were always accompanied by an automated probe that followed a couple of million miles behind. We knew about the portal planets, little bits of flotsam that whirled around the collapsars; the purpose of the drone was to come back and tell us in the event that a ship had smacked into a portal planet at .999 of the speed of light.

That particular catastrophe never happened, but one day a drone did come limping back alone. Its data were analyzed, and it turned out that the colonists' ship had been pursued by another vessel and destroyed. This happened near Aldebaran, in the constellation Taurus, but since "Aldebaranian" is a little hard to handle, they named the enemy Taurans.

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Colonizing vessels thenceforth went out protected by an armed guard. Often the armed guard went out alone, and finally the colonization effort itself slowed to a token trickle. The United Nations Exploratory and Colonization Group got shortened to UNEF, United Nations Exploratory Force, emphasis on the "force".

Then some bright lad in the General Assembly decided that we ought to field an army of footsoldiers, to guard the portal planets of the nearer collapsars. This led to the Elite Conscription Act of 1996 and the most rigorously selected army in the history of warfare.

So here we are, fifty men and fifty women, with IQ's over 150 and bodies of unusual health and strength, slogging elitely through the mud and slush of central Missouri, reflecting on how useful our skill in building bridges will be, on worlds where the only fluid will be your occasional standing pool of liquid helium.

III

About a month later, we left for our final training exercise; maneuvers on the planet Charon. Though nearing perihelion it was still more than twice as far from the sun as Pluto.

The troopship was a converted "cattlewagon," made to carry two hundred colonists and assorted bushes and beasts. Don't think it was roomy, though, just because there were half that many of us. Most of the excess space was taken up with extra reaction mass and ordnance.

The whole trip took three weeks, accelerating at 2 Gs halfway; decelerating the other half. Our top speed, as we roared by the orbit of Pluto, was around one twentieth of the speed of light—not quite enough for relativity to rear its complicated head.

Three weeks of carrying around twice as much weight as normal . . . it's no picnic. We did some cautious exercises three times a day, and remained horizontal as much as possible. Still, we had several broken bones and serious dislocations. The men had to wear special supporters. It was almost impossible to sleep, what with nightmares of choking and being crushed, and the necessity of rolling over periodically to prevent blood pooling and bedsores. One girl got so fatigued that she almost slept through the experience of having a rib rub through to the open air.

I'd been in space several times before, so when we finally stopped decelerating and went into free fall, it was nothing but a relief. But some people had never been out, except for our training on the Moon, and succumbed to the sudden vertigo and disorientation. The rest of us cleaned up after them, floating through the quarters with sponges and inspirators to suck up globules of partly-digested "Concentrate,

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High-protein, Low-residue, Beef Flavor (Soya)."

A shuttle took us down to the surface in three trips. I waited for the last one, along with everybody else who wasn't bothered by free fall.

We had a good view of Charon, coming down from orbit. There wasn't much to see, though. It was just a dim, off-white sphere with a few smudges on it. We landed about two hundred meters from the base. A pressurized crawler came out and mated with the ferry, so we didn't have to suit up. We clanked and squeaked up to the main building, a featureless box of grayish plastic.

Inside, the walls were the same inspired color. The rest of the company was sitting at desks, chattering away. There was a seat next to Freeland.

"Jeff—feeling better?" He still looked a little pale.

"If the gods had meant for man to survive in free fall, they would have given him a cast-iron glottis. Somewhat better. Dying for a smoke."

"Yeah."

"*You* seemed to take it all right. Went up in school, didn't you?"

"Senior thesis in vacuum welding, yeah, three weeks in Earth orbit." I sat back and reached for my weed box, for the thousandth time. It still wasn't there, of course. The Life Support Unit didn't want to handle nicotine and THC.

"Training was bad enough," Jeff groused, "but *this* crap—"

"I don't know." I'd been thinking about it. "It might just all be worth it."

"Hell, no—this is a *space* war, let Star Fleet take care of it . . . they're just going to send us out and either we sit for fifty years on some damn ice cube of a portal planet, or we get—"

"Well, Jeff, you've got to look at it the other way, too. Even if there's only one chance in a thousand that we'll be doing some good, keeping the Taurans—"

"Tench-hut!" We stood up in a raggety-ass fashion, by twos and threes. The door opened and a full major came in. I stiffened a little. He was the highest-ranking officer I'd ever seen. He had a row of ribbons stitched into his coveralls, including a purple strip meaning he'd been wounded in combat, fighting in the old American army. Must have been that Indochina thing, but it had fizzled out before I was born. He didn't look that old.

"Sit, sit." He made a patting motion with his hand. Then he put his hands on his hips and scanned the company with a small smile on his face. "Welcome to Charon. You picked a lovely day to land; the temperature outside is a summery eight point one five degrees Absolute. We expect little change for the next two centuries or so." Some of us laughed half-heartedly.

"You'd best enjoy the tropical climate here at Miami Base, enjoy it while you can. We're on the center

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of sunside here, and most of your training will be on darkside. Over there, the temperature drops to a chilly two point zero eight.

"You might as well regard all the training you got on Earth and the Moon as just a warm-up exercise, to give you a fair chance of surviving Charon. You'll have to go through your whole repertory here: tools, weapons, maneuvers. And you'll find that, at these temperatures, tools don't work the way they should, weapons don't want to fire. And people move v-e-r-y cautiously."

He studied the clipboard in his hand. "Right now, you have forty-nine women and forty-eight men. Two deaths, one psychiatric release. Having read an outline of your training program, I'm frankly surprised that so many of you pulled through.

"But you might as well know that I won't be displeased if as few as fifty of you graduate from this final phase. And the only way not to graduate is to die. Here. The only way anybody gets back to Earth—including me—is after a combat tour.

"You will complete your training in one month. From here you go to Stargate collapsar, a little over two lights away. You will stay at the settlement on Stargate I, the largest portal planet, until replacements arrive. Hopefully, that will be no more than a month; another group is due here as soon as you leave.

"When you leave Stargate, you will be going to a strategically important collapsar, set up a military base there, and fight the enemy, if attacked. Otherwise, maintain the base until further orders."

"The last two weeks of your training will consist of constructing such a base, on darkside. There you will be totally isolated from Miami Base: no communication, no medical evacuation, no resupply. Sometime before the two weeks are up, your defense facilities will be evaluated in an attack by guided drones. They will be armed.

"All of the permanent personnel here on Charon are combat veterans. Thus, all of us are forty to fifty years of age, but I think we can keep up with you. Two of us will be with you at all times, and will accompany you at least as far as Stargate. They are Captain Sherman Stott, your company commander, and Sergeant Octavio Cortez, your first sergeant. Gentlemen?"

Two men in the front row stood easily and turned to face us. Captain Stott was a little smaller than the major, but cut from the same mold; face hard and smooth as porcelain, cynical half-smile, a precise centimeter of beard framing a large chin, looking thirty at the most. He wore a large, gunpowder-type pistol on his hip.

Sergeant Cortez was another story. His head was shaved and the wrong shape; flattened out on one side where a large piece of skull had obviously been taken out. His face was very dark and seamed with wrinkles

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and scars. Half his left ear was missing and his eyes were as expressive as buttons on a machine. He had a moustache-and-beard combination that looked like a skinny white caterpillar taking a lap around his mouth. On anybody else, his schoolboy smile might look pleasant, but he was about the ugliest, meanest-looking creature I'd ever seen. Still, if you didn't look at his head and considered the lower six feet or so, he could pose as the "after" advertisement for a body-building spa. Neither Stott nor Cortez wore any ribbons. Cortez had a small pocket-laser suspended in a magnetic rig, sideways, under his left armpit. It had wooden grips that were worn very smooth.

"Now, before I turn you over to the tender mercies of these two gentlemen, let me caution you again:

"Two months ago there was not a living soul on this planet, just some leftover equipment from the expedition of 1991. A working force of forty-five men struggled for a month to erect this base. Twenty-four of them, more than half, died in the construction of it. This is the most dangerous planet men have ever tried to live on, but the places you'll be going will be this bad and worse. Your cadre will try to keep you alive for the next month. Listen to them . . . and follow their example; all of them have survived here for longer than you'll have to. Captain?" The captain stood up as the major went out the door.

"Tench-*hut*!" The last syllable was like an explosion and we all jerked to our feet.

"Now I'm only gonna say this *once* so you better listen," he growled. "We *are* in a combat situation here and in a combat situation there is only *one* penalty for disobedience and insubordination." He jerked the pistol from his hip and held it by the barrel, like a club. "This is an Army model 1911 automatic *pistol* caliber .45 and it is a primitive, but effective, weapon. The sergeant and I are authorized to use our weapons to kill to enforce discipline, don't make us do it because we will. We *will*." He put the pistol back. The holster snap made a loud crack in the dead quiet.

"Sergeant Cortez and I between us have killed more people than are sitting in this room. Both of us fought in Vietnam on the American side and both of us joined the United Nations International Guard more than ten years ago. I took a break in grade from major for the privilege of commanding this company, and First Sergeant Cortez took a break from sub-major, because we are both *combat* soldiers and this is the first *combat* situation since 1974.

"Keep in mind what I've said while the First Sergeant instructs you more specifically in what your duties will be under this command. Take over, Sergeant." He turned on his heel and strode out of the room, with the little smile on his face that hadn't changed one millimeter during the whole harangue.

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The First Sergeant moved like a heavy machine with lots of ball bearings. When the door hissed shut he swiveled ponderously to face us and said, "At ease, siddown," in a surprisingly gentle voice. He sat on a table in the front of the room. It creaked—but held.

"Now the captain talks scary and I look scary, but we both mean well. You'll be working pretty closely with me, so you better get used to this thing I've got hanging in front of my brain. You probably won't see the captain much, except on maneuvers."

He touched the flat part of his head. "And speaking of brains, I still have just about all of mine, in spite of Chinese efforts to the contrary. All of us old vets who mustered into UNEF had to pass the same criteria that got you drafted by the Elite Conscription Act. So I suspect all of you are smart and tough—but just keep in mind that the captain and I are smart and tough *and* experienced."

He flipped through the roster without really looking at it. "Now, as the captain said, there'll be only one kind of disciplinary action, on maneuvers. Capital punishment. But normally *we* won't have to kill you for disobeying; Charon'll save us the trouble.

"Back in the billeting area, it'll be another story. We don't much care what you do inside, but once you suit up and go outside, you've gotta have discipline that would shame a Centurian. There will be situations where one stupid act could kill us all.

"Anyhow, the first thing we've gotta do is get you fitted to your fighting suits. The armorer's waiting at your billet; he'll take you one at a time. Let's go."

IV

"Now I know you got lectured and lectured on what a fighting suit can do, back on Earth." The armorer was a small man, partially bald, with no insignia of rank on his coveralls. Sergeant Cortez told us to call him "sir," since he was a lieutenant.

"But I'd like to reinforce a couple of points, maybe add some things your instructors Earthside weren't clear about, or couldn't know. Your First Sergeant was kind enough to consent to being my visual aid. Sergeant?"

Cortez slipped out of his coveralls and came up to the little raised platform where a fighting suit was standing, popped open like a man-shaped clam. He backed into it and slipped his arms into the rigid sleeves. There was a click and the thing swung shut with a sigh. It was bright green with CORTEZ stenciled in white letters on the helmet.

"Camouflage, Sergeant." The green faded to white, then dirty gray. "This is good camouflage for Charon, and most of your portal planets," said Cortez, from a deep well. "But there are several other combinations available." The gray dap-

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pled and brightened to a combination of greens and browns: "Jungle." Then smoothed out to a hard light ochre: "Desert." Dark brown, darker, to a deep flat black: "Night or space."

"Very good, Sergeant. To my knowledge, this is the only feature of the suit which was perfected after your training. The control is around your left wrist and is admittedly awkward. But once you find the right combination, it's easy to lock in.

"Now, you didn't get much in-suit training Earthside because we didn't want you to get used to using the thing in a friendly environment. The fighting suit is the deadliest personal weapon ever built, and with no weapon it is easier for the user to kill himself through carelessness. Turn around, Sergeant.

"Case in point." He tapped a square protuberance between the shoulders. "Exhaust fins. As you know the suit tries to keep you at a comfortable temperature no matter what the weather's like outside. The material of the suit is as near to a perfect insulator as we could get, consistent with mechanical demands. Therefore, these fins get *hot*—especially hot, compared to darkside temperatures—as they bleed off the body's heat.

"All you have to do is lean up against a boulder of frozen gas; there's lots of it around. The gas will sublime off faster than it can escape from the fins; in escaping, it will push against the surrounding 'ice' and fracture it . . . and in about one hundredth of a second, you have the equivalent of a hand grenade going off right below your neck. You'll never feel a thing.

"Variations on this theme have killed eleven people in the past two months. And they were just building a bunch of huts.

"I assume you know how easily the waldo capabilities can kill you or your companions. Anybody want to shake hands with the sergeant?" He stepped over and clasped his glove. "He's had lots of practice. Until *you* have, be extremely careful. You might scratch an itch and wind up bleeding to death. Remember, semi-logarithmic response: two pounds' pressure exerts five pounds' force; three pounds gives ten; four pounds' twenty-three; five pounds, forty-seven. Most of you can muster up a grip of well over a hundred pounds. Theoretically, you could rip a steel girder in two with that, amplified. Actually, you'd destroy the material of your gloves and, at least on Charon, die very quickly. It'd be a race between decompression and flash-freezing. You'd be the loser.

"The leg waldos are also dangerous, even though the amplification is less extreme. Until you're really skilled, don't try to run, or jump. You're likely to trip, and that means you're likely to die.

"Charon's gravity is three-fourths of Earth normal, so it's not too bad.

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But on a really small world, like Luna, you could take a running jump and not come down for twenty minutes, just keep sailing over the horizon. Maybe bash into a mountain at eighty meters per second. On a small asteroid, it'd be no trick at all to run up to escape velocity and be off on an informal tour of intergalactic space. It's a slow way to travel.

"Tomorrow morning, we'll start teaching you how to stay alive inside of this infernal machine. The rest of the afternoon and evening, I'll call you one at a time to be fitted. That's all, Sergeant."

Cortez went to the door and turned the stopcock that let air into the air lock. A bank of infrared lamps went on to keep the air from freezing inside it. When the pressures were equalized, he shut the stopcock, unclamped the door and stepped in, clamping it shut behind him. A pump hummed for about a minute, evacuating the air lock, then he stepped out and sealed the outside door. It was pretty much like the ones on Luna.

"First I want Private Omar Almizar. The rest of you can go find your bunks. I'll call you over the squawker."

"Alphabetical order, sir?"

"Yep. About ten minutes apiece. If your name begins with Z, you might as well get sacked."

That was Rogers. She probably *was* thinking about getting sacked.

V

The sun was a hard white point directly overhead. It was a lot brighter than I had expected it to be; since we were eighty A. U.'s out, it was only 1/6400th as bright as it is on Earth. Still, it was putting out about as much light as a powerful streetlamp.

"This is considerably more light than you'll have on a portal planet," Captain Stott's voice crackled in our collective ear. "Be glad that you'll be able to watch your step."

We were lined up, single file, on a permaplast sidewalk connecting the billet and the supply hut. We'd practiced walking inside, all morning, and this wasn't any different except for the exotic scenery. Though the light was rather dim, you could see all the way to the horizon quite clearly, with no atmosphere in the way. A black cliff that looked too regular to be natural stretched from one horizon to the other, passing within a kilometer of us. The ground was obsidian-black, mottled with patches of white, or bluish, ice. Next to the supply hut was a small mountain of snow in a bin marked OXYGEN.

The suit was fairly comfortable, but it gave you the odd feeling of being simultaneously a marionette and a puppeteer. You apply the impulse to move your leg and the suit picks it up and magnifies it and moves your leg for you.

"Today we're only going to walk

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around the company area and nobody will *leave* the company area." The captain wasn't wearing his .45, but he had a laser-finger like the rest of us. And his was probably hooked up.

Keeping an interval of at least two meters between each person, we stepped off the permaplast and followed the captain over the smooth rock. We walked carefully for about an hour, spiraling out, and finally stopped at the far edge of the perimeter.

"Now everybody pay close attention. I'm going out to that blue slab of ice"—it was a big one, about twenty meters away—"and show you something that you'd better know if you want to live."

He walked out a dozen confident steps. "First I have to heat up a rock—filters down." I slapped the stud under my armpit and the filter slid into place over my image converter. The captain pointed his finger at a black rock the size of a basketball and gave it a short burst. The glare rolled a long shadow of the captain over us and beyond. The rock shattered into a pile of hazy splinters.

"It doesn't take long for these to cool down." He stooped and picked up a piece. "This one is probably twenty or twenty-five degrees. Watch." He tossed the "warm" rock on the ice slab. It skittered around in a crazy pattern and shot off the side. He tossed another one, and it did the same.

"As you know you are not quite *perfectly* insulated. These rocks are about the temperature of the soles of your boots. If you try to stand on a slab of hydrogen the same thing will happen to you. Except that the rock is *already* dead.

"The reason for this behavior is that the rock makes a slick interface with the ice—a little puddle of liquid hydrogen—and rides a few molecules above the liquid on a cushion of hydrogen vapor. This makes the rock, or *you*, a frictionless bearing as far as the ice is concerned and you *can't* stand up without any friction under your boots.

"After you have lived in your suit for a month or so you *should* be able to survive falling down, but right *now* you just don't know enough. Watch."

The captain flexed and hopped up onto the slab. His feet shot out from under him and he twisted around in midair, landing on hands and knees. He slipped off and stood on the ground.

"The idea is to keep your exhaust fins from making contact with the frozen gas. Compared to the ice they are as hot as a blast furnace and contact with any weight behind it will result in an explosion."

After that demonstration, we walked around for another hour or so, and returned to the billet. Once through the air lock, we had to mill around for a while, letting the suits get up to something like room tem-

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perature. Somebody came up and touched helmets with me.

"William?" She had MC COY stenciled above her faceplate.

"Hi, Sean. Anything special?"

"I just wondered if you had anyone to sleep with tonight."

That's right; I'd forgotten, there wasn't any sleeping roster here. Everybody just chose his own partner. "Sure, I mean, uh, no . . . no, I haven't asked anybody, sure, if you want to . . ."

"Thanks, William. See you later." I watched her walk away and thought that if anybody could make a fighting suit look sexy, it'd be Sean. But even Sean couldn't.

Cortez decided we were warm enough and led us to the suit room where we backed the things into place and hooked them up to the charging plates—each suit had a little chunk of plutonium that would power it for several years, but we were supposed to run on fuel cells as much as possible. After a lot of shuffling around, everybody finally got plugged in and we were allowed to unsuit, ninety-seven naked chickens squirming out of bright green eggs. It was *cold*—the air, the floor, and especially the suits—and we made a pretty disorderly exit toward the lockers.

I slipped on tunic, trousers and sandals and was still cold. I took my cup and joined the line for soya, everybody jumping up and down to keep warm.

"How c-cold, do you think, it is, M-Mandella?" That was McCoy.

"I don't, even want, to think, about it." I stopped jumping and rubbed myself as briskly as possible, while holding a cup in one hand. "At least as cold as Missouri was."

"Ung . . . wish they'd, get some damn heat in, this place." It always effects the small girls more than anybody else. McCoy was the littlest one in the company, a waspwaist doll barely five feet high.

"They've got the airco going. It can't be long now."

"I wish I, was a big, slab of, meat like, you."

I was glad she wasn't.

VI

We had our first casualty on the third day, learning how to dig holes.

With such large amounts of energy stored in a soldier's weapons, it wouldn't be practical for him to hack out a hole in the frozen ground with the conventional pick and shovel. Still, you can launch grenades all day and get nothing but shallow depressions—so the usual method is to bore a hole in the ground with the hand laser, drop a timed charge in after it's cooled down and, ideally, fill the hole with stuff. Of course, there's not much loose rock on Charon, unless you've already blown a hole nearby.

The only difficult thing about the procedure is getting away. To be safe, we were told, you've got to either be behind something really solid, or be at least a hundred meters

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away. You've got about three minutes after setting the charge, but you can't just spring away. Not on Charon.

The accident happened when we were making a really deep hole, the kind you want for a large underground bunker. For this, we had to blow a hole, then climb down to the bottom of the crater and repeat the procedure again and again until the hole was deep enough. Inside the crater we used charges with a five-minute delay, but it hardly seemed enough time--you really had to go slow, picking your way up the crater's edge.

Just about everybody had blown a double hole; everybody but me and three others. I guess we were the only ones paying really close attention when Bovanovitch got into trouble. All of us were a good two hundred meters away. With my image converter tuned up to about forty power, I watched her disappear over the rim of the crater. After that, I could only listen in on her conversation with Cortez.

"I'm on the bottom, Sergeant." Normal radio procedure was suspended for these maneuvers; only the trainee and Cortez could broadcast.

"O.K., move to the center and clear out the rubble. Take your time. No rush until you pull the pin."

"Sure, Sergeant." We could hear small echoes of rocks clattering; sound conduction through her boots. She didn't say anything for several minutes.

"Found bottom." She sounded a little out of breath.

"Ice, or rock?"

"Oh, it's rock, Sergeant. The greenish stuff."

"Use a low setting, then. One point two, dispersion four."

"God darn it, Sergeant, that'll take forever."

"Yeah, but that stuff's got hydrated crystals in it—heat it up too fast and you might make it fracture. And we'd just have to leave you there, girl."

"O.K., one point two dee four." The inside edge of the crater flickered red with reflected laser light.

"When you get about half a meter deep, squeeze it up to dee two."

"Roger." It took her exactly seventeen minutes, three of them at dispersion two. I could imagine how tired her shooting arm was.

"Now rest for a few minutes. When the bottom of the hole stops glowing, arm the charge and drop it in. Then *walk* out. Understand? You'll have plenty of time."

"I understand, Sergeant. Walk out." She sounded nervous. Well, you don't often have to tiptoe away from a twenty microton tachyon bomb. We listened to her breathing for a few minutes.

"Here goes." Faint slithering sound of the bomb sliding down.

"Slow and easy now, you've got five minutes."

"Y-yeah. Five." Her footsteps started out slow and regular. Then, after she started climbing the side,

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the sounds were less regular; maybe a little frantic. And with four minutes to go—

"Crap!" A loud scraping noise, then clatters and bumps.

"What's wrong, Private?"

"Oh, crap." Silence. "Crap!"

"Private, you don't wanna get shot, you *tell me what's wrong!*"

"I . . . I'm stuck, damn rockslide . . . DO SOMETHING I can't move. I can't move I, I—"

"Shut up! How deep?"

"Can't move my crap, my damn legs HELP ME—"

"Then damn it use your arms—push!—you can move a ton with each hand." Three minutes.

Then she stopped cussing and started to mumble, in Russian, I guess, a low monotone. She was panting and you could hear rocks tumbling away.

"I'm free." Two minutes.

"Go as fast as you can." Cortez's voice was flat, emotionless.

At ninety seconds she appeared crawling over the rim. "Run, girl . . . you better run." She ran five or six steps and fell, skidded a few meters and got back up, running; fell again, got up again—

It looked like she was going pretty fast, but she had only covered about thirty meters when Cortez said, "All right, Bovanovitch, get down on yur stomach and lie still." Ten seconds, but she didn't hear him, or she wanted to get just a little more distance, and she kept running, careless leaping strides and at the high point of one leap there was a flash and a rumble and something big hit her below the neck and her headless body spun off end over end through space, trailing a red-black spiral of flash-frozen blood that settled gracefully to the ground, a path of crystal powder that nobody disturbed while we gathered rocks to cover the juiceless thing at the end of it.

That night Cortez didn't lecture us, didn't even show up for night-chop. We were all very polite to each other and nobody was afraid to talk about it.

I sacked with Rogers; everybody sacked with a good friend, but all she wanted to do was cry, and she cried so long and so hard that she got me doing it, too.

VII

"Fire team A—move out!" The twelve of us advanced in a ragged line toward the simulated bunker. It was about a kilometer away, across a carefully prepared obstacle course. We could move pretty fast, since all of the ice had been cleared from the field, but even with ten days' experience we weren't ready to do more than an easy jog.

I carried a grenade launcher, loaded with tenth-microton practice grenades. Everybody had their laser-fingers set at point oh eight dee one; not much more than a flashlight. This was a *simulated* attack—the bunker and its robot defender cost

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too much to be used once and thrown away.

"Team B follow. Team leaders, take over."

We approached a clump of boulders at about the halfway mark, and Potter, my team leader, said "Stop and cover." We clustered behind the rocks and waited for team B.

Barely visible in their blackened suits, the dozen men and women whispered by us. As soon as they were clear, they jogged left, out of our line of sight.

"Fire!" Red circles of light danced a half-click downrange, where the bunker was just visible. Five hundred meters was the limit for these practice grenades; but I might luck out, so I lined the launcher up on the image of the bunker, held it at a 45° angle and popped off a salvo of three.

Return fire from the bunker started before my grenades even landed. Its automatic lasers were no more powerful than the ones we were using, but a direct hit would deactivate your image converter, leaving you blind. It was setting down a random field of fire, not even coming close to the boulders we were hiding behind.

Three magnesium-bright flashes blinked simultaneously, about thirty meters short of the bunker. "Mandella! I thought you were supposed to be *good* with that thing."

"Damn it, Potter—it only throws half a click. Once we get closer, I'll lay 'em right on top, every time."

"*Sure* you will." I didn't say anything. She wouldn't be team leader forever. Besides, she hadn't been such a bad girl before the power went to her head.

Since the grenadier is the assistant team leader, I was slaved into Potter's radio and could hear B team talk to her.

"Potter, this is Freeman. Losses?"

"Potter here—no, looks like they were concentrating on you."

"Yeah, we lost three. Right now we're in a depression about eighty, a hundred meters down from you. We can give cover whenever you're ready."

"O.K., start." Soft click: "A team, follow me." She slid out from behind the rock and turned on the faint pink beacon beneath her powerpack. I turned on mine and moved out to run alongside of her and the rest of the team fanned out in a trailing wedge. Nobody fired while B team laid down a cover for us.

All I could hear was Potter's breathing and the soft *crunch-crunch* of my boots. Couldn't see much of anything, so I tongued the image converter up to a log two intensification. That made the image kind of blurry but adequately bright. Looked like the bunker had B team pretty well pinned down; they were getting quite a roasting. All of their return fire was laser; they must have lost their grenadier.

"Potter, this is Mandella. Shouldn't we take some of the heat off B team?"

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"Soon as I can find us good enough cover. Is that all right with you? Private?" She'd been promoted to corporal for the duration of the exercise.

We angled to the right and laid down behind a slab of rock. Most of the others found cover nearby, but a few had to just hug the ground.

"Freeman, this is Potter."

"Potter, this is Smithy. Freeman's out; Samuels is out. We only have five men left. Give us some cover so we can get—"

"Roger, Smithy."—*click*—"Open up, A team. The B's are really hurtin'."

I peeked out over the edge of the rock. My rangefinder said that the bunker was about three hundred fifty meters away, still pretty far. I aimed just a smidgeon high and popped three, then down a couple of degrees and three more. The first ones overshot by about twenty meters, then the second salvo flared up directly in front of the bunker. I tried to hold on that angle and popped fifteen, the rest of the magazine, in the same direction.

I should have ducked down behind the rock to reload, but I wanted to see where the fifteen would land, so I kept my eyes on the bunker while I reached back to unclip another magazine—

When the laser hit my image converter there was a red glare so intense it seemed to go right through my eyes and bounce off the back of my skull. It must have been only a few milliseconds before the converter overloaded and went blind, but the bright green afterimage hurt my eyes for several minutes.

Since I was officially "dead," my radio automatically cut off and I had to remain where I was until the mock battle was over. With no sensory input besides the feel of my own skin—and it ached where the image converter had shone on it—and the ringing in my ears, it seemed like an awfully long time. Finally, a helmet clanked against mine:

"You O.K., Mandella?" Potter's voice.

"Sorry, I died of boredom twenty minutes ago."

"Stand up and take my hand." I did so and we shuffled back to the billet. It must have taken over an hour. She didn't say anything more, all the way back—it's a pretty awkward way to communicate—but after we'd cycled through the air lock and warmed up, she helped me undog my suit. I got ready for a mild tongue-lashing, but when the suit popped open, before I could even get my eyes adjusted to the light, she grabbed me around the neck and planted a wet kiss on my mouth.

"Nice shooting, Mandella."

"Huh?"

"The last salvo before you got hit—four direct hits; the bunker decided it was knocked out, and all we had to do was walk the rest of the way."

"Great." I scratched my face un-

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der the eyes and some dry skin flaked off. She giggled.

"You should see yourself, you look like . . ."

"All personnel report to the assembly area." That was the captain's voice. Bad news.

She handed me a tunic and sandals. "Let's go."

The assembly area/chop hall was just down the corridor. There was a row of roll-call buttons at the door; I pressed the one beside my name. Four of the names were covered with black tape. That was good, we hadn't lost anybody else during today's maneuvers.

The captain was sitting on the raised dais, which at least meant we didn't have to go through the tench-hut bullshit. The place filled up in less than a minute; a soft chime indicated the roll was complete.

Captain Stott didn't stand up. "You did *fairly* well today, nobody got killed and I expected some to. In that respect you exceeded my expectations but in *every* other respect you did a poor job.

"I am glad you're taking good care of yourselves because each of you represents an investment of over a million dollars and one fourth of a human life.

"But in this simulated battle against a *very* stupid robot enemy, thirty-seven of you managed to walk into laser fire and be killed in a *simulated* way and since dead people require no food *you* will require no food, for the next three days. Each person who was a casualty in this battle will be allowed only two liters of water and a vitamin ration each day."

We knew enough not to groan or anything, but there were some pretty disgusted looks, especially on the faces that had singed eyebrows and a pink rectangle of sunburn framing their eyes.

"Mandella."

"Sir?"

"You are far and away the worst burned casualty. Was your image converter set on normal?"

Oh, crap. "No, sir. Log two."

"I see. Who was your team leader for the exercise?"

"Acting Corporal Potter, sir."

"Private Potter, did you order him to use image intensification?"

"Sir, I . . . I don't remember."

"You don't. Well as a memory exercise you may join the dead people. Is that satisfactory?"

"Yes, sir."

"Good. Dead people get one last meal tonight, and go on no rations starting tomorrow. Are there any questions?" He must have been kidding. "All right. Dismissed."

I selected the meal that looked as if it had the most calories and took my tray over to sit by Potter.

"That was a quixotic damn thing to do. But thanks."

"Nothing. I've been wanting to lose a few pounds anyway." I couldn't see where she was carrying any extra.

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"I know a good exercise," I said. She smiled without looking up from her tray. "Have anybody for tonight?"

"Kind of thought I'd ask Jeff. . ."

"Better hurry, then. He's lusting after Uhuru." Well, that was mostly true. Everybody did.

"I don't know. Maybe we ought to save our strength. That third day . . ."

"Come on," I scratched the back of her hand lightly with a fingernail. "We haven't sacked since Missouri. Maybe I've learned something new."

"Maybe you have." She tilted her head up at me in a sly way. "O.K."

Actually, she was the one with the new trick. The French corkscrew, she called it. She wouldn't tell me who taught it to her, though. I'd like to shake his hand.

VIII

The two weeks' training around Miami Base eventually cost us eleven lives. Twelve, if you count Dahlquist. I guess having to spend the rest of your life on Charon, with a hand and both legs missing, is close enough to dying.

Little Foster was crushed in a landslide and Freeland had a suit malfunction that froze him solid before we could carry him inside. Most of the other deaders were people I didn't know all that well. But they all hurt. And they seemed to make us more scared rather than more cautious.

Now darkside. A flier brought us over in groups of twenty, and set us down beside a pile of building materials, thoughtfully immersed in a pool of helium II.

We used grapples to haul the stuff out of the pool. It's not safe to go wading, since the stuff crawls all over you and it's hard to tell what's underneath: you could walk out onto a slab of hydrogen and be out of luck.

I'd suggested that we try to boil away the pool with our lasers, but ten minutes of concentrated fire didn't drop the helium level appreciably. It didn't boil, either; helium II is a "superfluid," so what evaporation there was had to take place evenly, all over the surface. No hot spots, so no bubbling.

We weren't supposed to use lights, to "avoid detection." There was plenty of starlight, with your image converter cranked up to log three or four, but each stage of amplification meant some loss of detail. By log four, the landscape looked like a crude monochrome painting, and you couldn't read the names on people's helmets unless they were right in front of you.

The landscape wasn't all that interesting, anyhow. There were half a dozen medium-sized meteor craters—all with exactly the same level of helium II in them—and the suggestion of some puny mountains just over the horizon. The uneven ground was the consistency of frozen spiderwebs; every time you put your foot down, you'd sink half an inch

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with a squeaking crunch. It could get on your nerves.

It took most of a day to pull all the stuff out of the pool. We took shifts napping, which you could do either standing up, sitting, or lying on your stomach. I didn't do well in any of those positions, so I was anxious to get the bunker built and pressurized.

We couldn't build the thing underground—it'd just fill up with helium II—so the first thing to do was to build an insulating platform, a permaplast-vacuum sandwich three layers tall.

I was an acting corporal, with a crew of ten people. We were carrying the permaplast layers to the building site—two people can carry one easily—when one of "my" men slipped and fell on his back.

"Damn it, Singer, watch your step." We'd had a couple of deaders that way.

"Sorry, Corporal. I'm bushed, just got my feet tangled up."

"Yeah, just watch it." He got back up all right, and with his partner placed the sheet and went back to get another.

I kept my eye on him. In a few minutes he was practically staggering, not easy to do in that suit of cybernetic armor.

"Singer! After you set that plank, I want to see you."

"O.K." He labored through the task and mooched over.

"Let me check your readout." I opened the door on his chest to expose the medical monitor. His temperature was two degrees high; blood pressure and heart rate both elevated. Not up to the red line, though.

"You sick or something?"

"Hell, Mandella, I feel O.K., just tired. Since I fell I've been a little dizzy."

I chinned the medic's combination. "Doc, this is Mandella. You wanna come over here for a minute?"

"Sure, where are you?" I waved and he walked over from poolside.

"What's the problem?" I showed him Singer's readout.

He knew what all the other little dials and things meant, so it took him a while. "As far as I can tell, Mandella . . . he's just hot."

"Hell, I coulda told you that," said Singer.

"Maybe you better have the armorer take a look at his suit." We had two people who'd taken a crash course in suit maintenance; they were our "armorers."

I chinned Sanchez and asked him to come over with his tool kit.

"Be a couple of minutes, Corporal. Carryin' a plank."

"Well, put it down and get on over here." I was getting an uneasy feeling. Waiting for him, the medic and I looked over Singer's suit.

"Uh-oh," Doc Jones said. "Look at this." I went around to the back and looked where he was pointing. Two of the fins on the heat exchanger were bent out of shape.

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"What is wrong?" Singer asked.

"You fell on your heat exchanger, right?"

"Sure, Corporal—that's it, it must not be working right."

"I don't think it's working at *all*," said Doc.

Sanchez came over with his diagnostic kit and we told him what had happened. He looked at the heat exchanger, then plugged a couple of jacks into it and got a digital readout from a little monitor in his kit. I didn't know what it was measuring, but it came out zero to eight decimal places.

Heard a soft click, Sanchez chinning my private frequency. "Corporal, this guy's a deader."

"What? Can't you fix the damn thing?"

"Maybe . . . maybe I could, if I could take it apart. But there's no way—"

"Hey! Sanchez?" Singer was talking on the general freak. "Find out what's wrong?" He was panting.

Click. "Keep your pants on, man, we're working on it." *Click*. "He won't last long enough for us to get the bunker pressurized. And I can't work on the heat exchanger from outside of the suit."

"You've got a spare suit, haven't you?"

"Two of 'em, the fit-anybody kind. But there's no place . . . say . . ."

"Right. Go get one of the suits warmed up." I chinned the general freak. "Listen, Singer, we've gotta get you out of that thing. Sanchez has a spare suit, but to make the switch, we're gonna have to build a house around you. Understand?"

"Huh-uh."

"Look, we'll just make a box with you inside, and hook it up to the life-support unit. That way you can breathe while you make the switch."

"Soun's pretty compis . . . complicated t'me."

"Look, just come along—"

"I'll be all right, man, jus' lemme res' . . ."

I grabbed his arm and led him to the building site. He was really weaving. Doc took his other arm and between us, we kept him from falling over.

"Corporal Ho, this is Corporal Mandella." Ho was in charge of the life-support unit.

"Go away, Mandella, I'm busy."

"You're going to be busier." I outlined the problem to her. While her group hurried to adapt the LSU—for this purpose, it need only be an air hose and heater—I got my crew to bring around six slabs of permaplast, so we could build a big box around Singer and the extra suit. It would look like a huge coffin, a meter square and six meters long.

We set the suit down on the slab that would be the floor of the coffin. "O.K., Singer, let's go."

No answer.

"Singer!" He was just standing there. Doc Jones checked his readout.

"He's out, man, unconscious."

My mind raced. There might just

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be room for another person in the box. "Give me a hand here." I took Singer's shoulders and Doc took his feet, and we carefully laid him out at the feet of the empty suit.

Then I laid down myself, above the suit. "O.K., close 'er up."

"Look, Mandella, if anybody goes in there, it oughta be me."

"No, Doc. *My* job. My man." That sounded all wrong. William Mandella, boy hero.

They stood a slab up on edge—it had two openings for the LSU input and exhaust—and proceeded to weld it to the bottom plank with a narrow laser beam. On Earth, we'd just use glue, but here the only fluid was helium, which has lots of interesting properties, but is definitely not sticky.

After about ten minutes we were completely walled up. I could feel the LSU humming. I switched on my suit light—the first time since we landed on darkside—and the glare made purple blotches dance in front of my eyes.

"Mandella, this is Ho. Stay in your suit at least two or three minutes. We're putting hot air in, but it's coming back just this side of liquid." I lay and watched the purple fade.

"O.K., it's still cold, but you can make it." I popped my suit. It wouldn't open all the way, but I didn't have too much trouble getting out. The suit was still cold enough to take some skin off my fingers and butt as I wiggled out.

I had to crawl feet-first down the coffin to get to Singer. It got darker fast, moving away from my light. When I popped his suit a rush of hot stink hit me in the face. In the dim light his skin was dark red and splotchy. His breathing was very shallow and I could see his heart palpitating.

First I unhooked the relief tubes—an unpleasant business—then the bio sensors, and then I had the problem of getting his arms out of their sleeves.

It's pretty easy to do for yourself. You twist this way and turn that way and the arm pops out. Doing it from the outside is a different matter: I had to twist his arm and then reach under and move the suit's arm to match—and it takes muscle to move a suit around from the outside.

Once I had one arm out it was pretty easy: I just crawled forward, putting my feet on the suit's shoulders, and pulled on his free arm. He slid out of the suit like an oyster slipping out of its shell.

I popped the spare suit and after a lot of pulling and pushing, managed to get his legs in. Hooked up the bio sensors and the front relief tube. He'd have to do the other one himself, it's too complicated. For the nth time I was glad not to have been born female; they have to have two of those damned plumber's friends, instead of just one and a simple hose.

I left his arms out of the sleeves. The suit would be useless for any

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kind of work, anyhow; waldos have to be tailored to the individual.

His eyelids fluttered. "Man . . . della. Where . . . the hell . . ."

I explained, slowly, and he seemed to get most of it. "Now I'm gonna close you up and go get into my suit. I'll have the crew cut the end off this thing and I'll haul you out. Got it?"

He nodded. Strange to see that—when you nod or shrug in a suit, it doesn't communicate anything.

I crawled into my suit, hooked up the attachments and chinned the general freak. "Doc, I think he's gonna be O.K. Get us out of here now."

"Will do." Ho's voice. The LUS hum was replaced by a chatter, then a throb; evacuating the box to prevent an explosion.

One corner of the seam grew red, then white and a bright crimson beam lanced through, not a foot away from my head. I scrunched back as far as I could. The beam slid up the seam and around three corners, back to where it started. The end of the box fell away slowly, trailing filaments of melted 'plast.

"Wait for the stuff to harden, Mandella."

"Sanchez, I'm not that stupid."

"Here you go." Somebody tossed a line to me. That *would* be smarter than dragging him out by myself. I threaded a long bight under his arms and tied it behind his neck. Then I scrambled out to help them pull, which was silly—they had a dozen people already lined up to haul.

Singer got out all right and was actually sitting up while Doc Jones checked his readout. People were asking me about it and congratulating me when suddenly Ho said "Look!" and pointed toward the horizon.

It was a black ship, coming in fast. I just had time to think it wasn't fair, they weren't supposed to attack until the last few days, and then the ship was right on top of us.

IX

We all flopped to the ground instinctively, but the ship didn't attack. It blasted braking rockets and dropped to land on skids. Then it skied around to come to a rest beside the building site.

Everybody had it figured out and was standing around sheepishly when the two suited figures stepped out of the ship.

A familiar voice crackled over the general freak. "Every *one* of you saw us coming in and not *one* of you responded with laser fire. It wouldn't have done any good but it would have indicated a certain amount of fighting spirit. You have a week or less before the real thing and since the sergeant and *I* will be here *I* will insist that you show a little more will to live. Acting Sergeant Potter."

"Here, sir."

"Get me a detail of twelve men to unload cargo. We brought a hundred small robot drones for *tar*get practice so that you might have at least a

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fighting chance, when a live target comes over.

"Move *now* we only have thirty minutes before the ship returns to Miami."

I checked, and it was actually more like forty minutes.

Having the captain and sergeant there didn't really make much difference; we were still on our own, they were just observing.

Once we got the floor down, it only took one day to complete the bunker. It was a gray oblong, featureless except for the air-lock blister and four windows. On top was a swivel-mounted bevawatt laser. The operator—you couldn't call him a "gunner"—sat in a chair holding dead-man switches in both hands. The laser wouldn't fire as long as he was holding one of those switches. If he let go, it would automatically aim for any moving aerial object and fire at will. Primary detection and aiming was by means of a kilometer-high antenna mounted beside the bunker.

It was the only arrangement that could really be expected to work, with the horizon so close and human reflexes so slow. You couldn't have the thing fully automatic, because in theory, friendly ships might also approach.

The aiming computer could choose up to twelve targets, appearing simultaneously—firing at the largest ones first. And it would get all twelve in the space of half a second.

The installation was partly protected from enemy fire by an efficient ablative layer that covered everything except the human operator. But then they *were* dead-man switches. One man above guarding eighty inside. The army's good at that kind of arithmetic.

Once the bunker was finished, half of us stayed inside at all times—feeling very much like targets—taking turns operating the laser, while the other half went on maneuvers.

About four clicks from the base was a large "lake" of frozen hydrogen; one of our most important maneuvers was to learn how to get around on the treacherous stuff.

It really wasn't too difficult. You couldn't stand up on it, so you had to belly down and slide.

If you had somebody to push you from the edge, getting started was no problem. Otherwise, you had to scrabble with your hands and feet, pushing down as hard as was practical, until you started moving, in a series of little jumps. Once started, you would keep going until you ran out of ice. You could steer a little bit by digging in, hand and foot, on the appropriate side, but you couldn't slow to a stop that way. So it was a good idea not to go too fast, and to be positioned in such a way that your helmet didn't absorb the shock of stopping.

We went through all the things we'd done on the Miami side; weapons practice, demolition, attack patterns. We also launched drones at ir-

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regular intervals, toward the bunker. Thus, ten or fifteen times a day, the operators got to demonstrate their skill in letting go of the handles as soon as the proximity light went on.

I had four hours of that, like everybody else. I was nervous until the first "attack," when I saw how little there was to it. The light went on, I let go, the gun aimed and when the drone peeped over the horizon—*zzt*! Nice touch of color, the molten metal spraying through space. Otherwise not too exciting.

So none of us were worried about the upcoming "graduation exercise," thinking it would be just more of the same.

Miami Base attacked on the thirteenth day with two simultaneous missiles streaking over opposite sides of the horizon at some forty kilometers per second. The laser vaporized the first one with no trouble, but the second got within eight clicks of the bunker before it was hit.

We were coming back from maneuvers, about a click away from the bunker. I wouldn't have seen it happen if I hadn't been looking directly at the bunker the moment of the attack.

The second missile sent a shower of molten debris straight toward the bunker. Eleven pieces hit, and, as we later reconstructed it, this is what happened.

The first casualty was Uhuru, pretty Uhuru inside the bunker, who was hit in the back and head and died instantly. With the drop in pressure, the LSU went into high gear. Freidman was standing in front of the main airco outlet and was blown into the opposite wall hard enough to knock him unconscious; he died of decompression before the others could get him to his suit.

Everybody else managed to stagger through the gale and get into their suits, but Garcia's suit had been holed and didn't do him any good.

By the time we got there, they had turned off the LSU and were welding up the holes in the wall. One man was trying to scrape up the unrecognizable mess that had been Uhuru. I could hear him sobbing and retching. They had already taken Garcia and Friedman outside for burial. The captain took over the repair detail from Potter. Sergeant Cortez led the sobbing man over to a corner and came back to work on cleaning up Uhuru's remains, alone. He didn't order anybody to help and nobody volunteered.

X

As a graduation exercise, we were unceremoniously stuffed into a ship—*Earth's Hope*, the same one we rode to Charon—and bundled off to Stargate at a little more than 1 G.

The trip seemed endless, about six months subjective time, and boring, but not as hard on the carcass as going to Charon had been. Captain Stott made us review our training orally, day by day, and we did exer-

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cises every day until we were worn to a collective frazzle.

Stargate I was like Charon's darkside, only more so. The base on Stargate I was smaller than Miami Base—only a little bigger than the one we constructed on darkside—and we were due to lay over a week to help expand the facilities. The crew there was very glad to see us; especially the two females, who looked a little worn around the edges.

We all crowded into the small dining hall, where Submajor Williamson, the man in charge of Stargate I, gave us some disconcerting news:

"Everybody get comfortable. Get off the tables, though, there's plenty of floor.

"I have some idea of what you just went through, training on Charon. I won't say it's all been wasted. But where you're headed, things will be quite different. Warmer."

He paused to let that soak in.

"Aleph Aurigae, the first collapsar ever detected, revolves around the normal star Epsilon Aurigae, in a twenty-seven-year orbit. The enemy has a base of operations, not on a regular portal planet of Aleph, but on a planet in orbit around Epsilon. We don't know much about the planet: just that it goes around Epsilon once every seven hundred forty-five days, is about three fourth the size of Earth, and has an albedo of 0.8, meaning it's probably covered with clouds. We can't say precisely how hot it will be, but judging from its distance from Epsilon, it's probably rather hotter than Earth. Of course, we don't know whether you'll be working . . . fighting on lightside or darkside, equator or poles. It's highly unlikely that the atmosphere will be breathable—at any rate, you'll stay inside your suits.

"Now you know exactly as much about where you're going as I do. Questions?"

"Sir," Stein drawled, "now we know where we're goin' . . . anybody know what we're goin' to do when we get there?"

Williamson shrugged. "That's up to your captain—and your sergeant, and the captain of *Earth's Hope*, and *Hope*'s logistic computer. We just don't have enough data yet, to project a course of action for you. It may be a long and bloody battle, it may be just a case of walking in to pick up the pieces. Conceivably, the Taurans might want to make a peace offer"—Cortez snorted—"in which case you would simply be part of our muscle, our bargaining power." He looked at Cortez mildly. "No one can say for sure."

The orgy that night was kind of amusing, but it was like trying to sleep in the middle of a raucous beach party. The only area big enough to sleep all of us was the dining hall; they draped a few bedsheets here and there for privacy, then unleashed Stargate's eighteen sex-starved men on our women, compliant and promiscuous by military custom—and law—but desiring noth-

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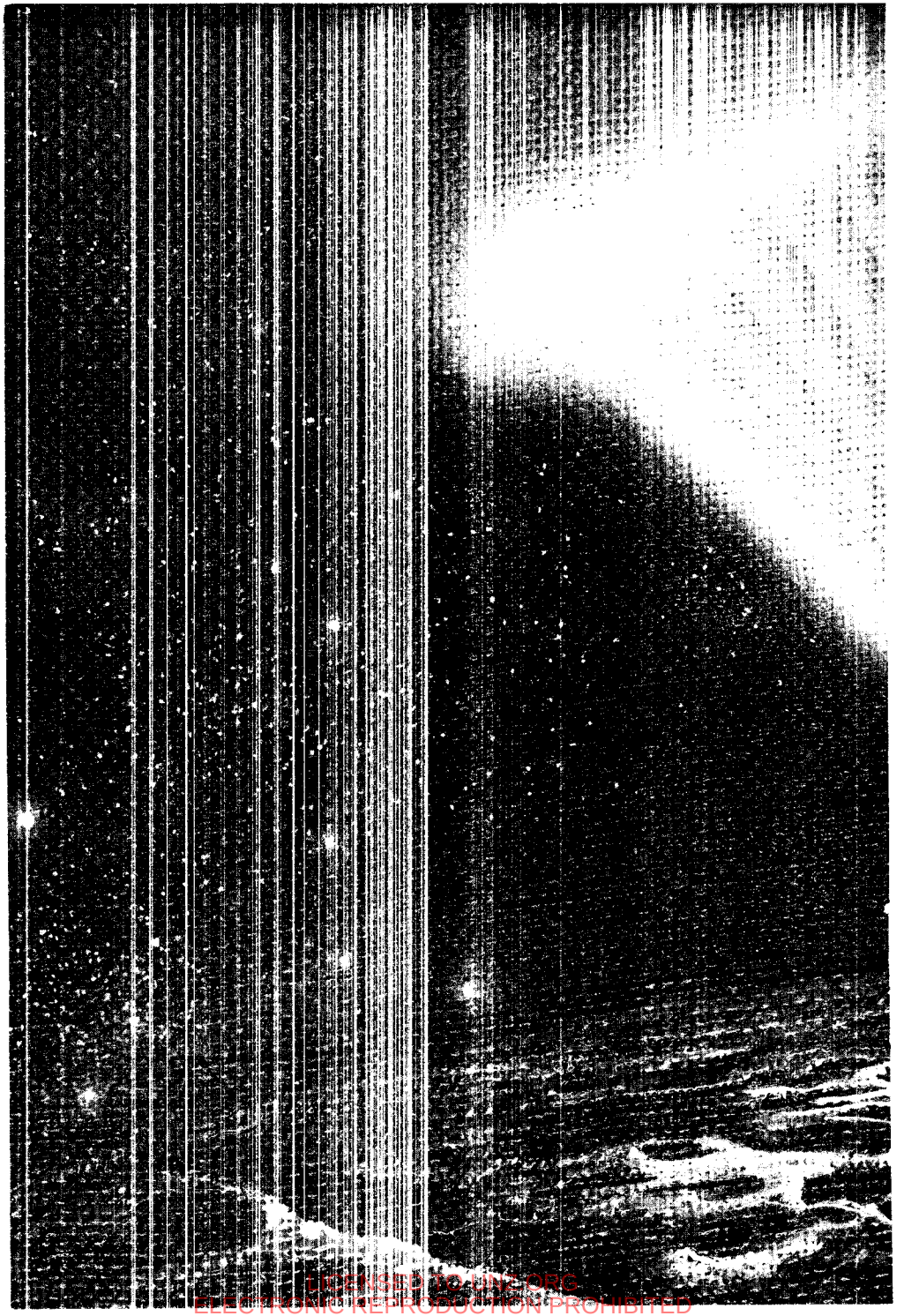

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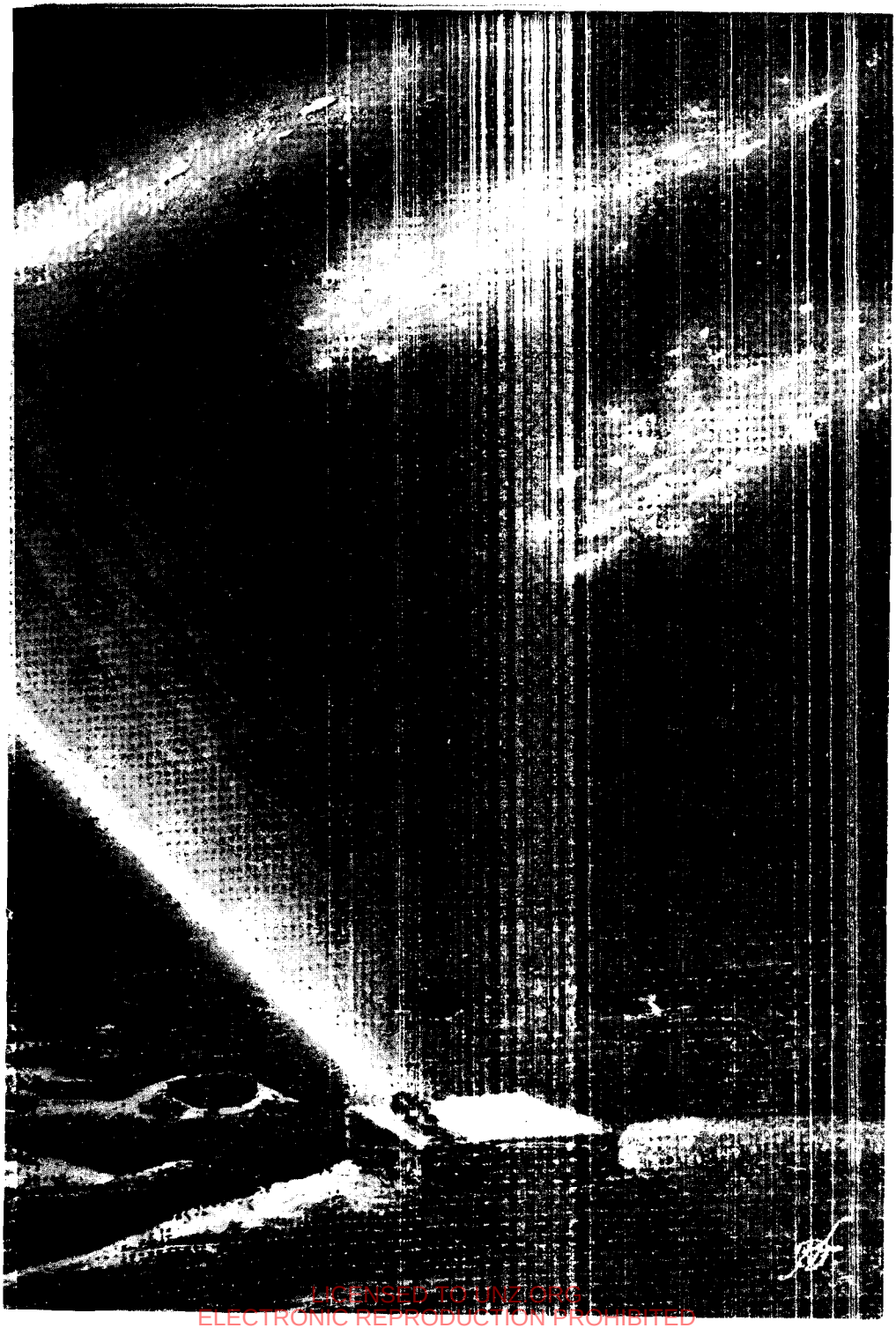

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ing so much as sleep on solid ground.

The eighteen men acted as if they were compelled to try as many permutations as possible, and their performance was impressive—in a strictly quantitative sense, that is.

The next morning—and every other morning we were on Stargate I—we staggered out of bed and into our suits, to go outside and work on the "new wing." Eventually, Stargate would be tactical and logistic headquarters for the war, with thousands of permanent personnel, guarded by half-a-dozen heavy cruisers in *Hope*'s class. When we started, it was two shacks and twenty people; when we left, it was four shacks and twenty people. The work was a breeze, compared to darkside, since we had all the light we needed, and got sixteen hours inside for every eight hours' work. And no drone attack for a final exam.

When we shuttled back up to the *Hope*, nobody was too happy about leaving—though some of the more popular females declared it'd be good to get some rest—Stargate was the last easy, safe assignment we'd have before taking up arms against the Taurans. And as Williamson had pointed out the first day, there was no way of predicting what that would be like.

Most of us didn't feel too enthusiastic about making a collapsar jump, either. We'd been assured that we wouldn't even feel it happen, just free fall all the way.

I wasn't convinced. As a physics student, I'd had the usual courses in general relativity and theories of gravitation. We only had a little direct data at that time—Stargate was discovered when I was in grade school—but the mathematical model seemed clear enough.

The collapsar Stargate was a perfect sphere about three kilometers in radius. It was suspended forever in a state of gravitational collapse that should have meant its surface was dropping toward its center at nearly the speed of light. Relativity propped it up, at least gave it the illusion of being there . . . the way all reality becomes illusory and observer-oriented when you study general relativity, or Buddhism.

At any rate, there would be a theoretical point in spacetime when one end of our ship was just above the surface of the collapsar, and the other end was a kilometer away—in our frame of reference. In any sane universe, this would set up tidal stresses and tear the ship apart, and we would be just another million kilograms of degenerate matter on the theoretical surface, rushing headlong to nowhere for the rest of eternity; or dropping to the center in the next trillionth of a second. You pays your money and you takes your frame of reference.

But they were right. We blasted away from Stargate I, made a few course corrections and then just dropped, for about an hour.

Then a bell rang and we sank into

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our cushions under a steady two gravities of deceleration. We were in enemy territory.

XI

We'd been decelerating at two gravities for almost nine days when the battle began. Lying on our couches being miserable, all we felt were two soft bumps, missiles being released. Some eight hours later, the squawkbox crackled: "Attention, all crew. This is the captain." Quinsana, the pilot, was only a lieutenant, but was allowed to call himself captain aboard the vessel, where he outranked all of us, even Captain Stott. "You grunts in the cargo hold can listen, too.

"We just engaged the enemy with two fifty-bevaton tachyon missiles, and have destroyed both the enemy vessel and another object which it had launched approximately three microseconds before.

"The enemy has been trying to overtake us for the past one hundred seventy-nine hours, ship time. At the time of the engagement, the enemy was moving at a little over half the speed of light, relative to Aleph, and was only about thirty AU's from *Earth's Hope*. It was moving at .47c relative to us, and thus we would have been coincident in space-time"—rammed!—"in a little more than nine hours. The missiles were launched at 0719 ship's time, and destroyed the enemy at 1540, both tachyon bombs detonating within a thousand clicks of the enemy objects."

The two missiles were a type whose propulsion system itself was only a barely-controlled tachyon bomb. They accelerated at a constant rate of 100 Gs, and were traveling at a relativistic speed by the time the nearby mass of the enemy ship detonated them.

"We expect no further interference from enemy vessels. Our velocity with respect to Aleph will be zero in another five hours; we will then begin to journey back. The return will take twenty-seven days." General moans and dejected cussing. Everybody knew all that already, of course; but we didn't care to be reminded of it.

So after another month of logycalisthenics and drill, at a constant 2 G's, we got our first look at the planet we were going to attack. Invaders from outer space, yes, sir.

It was a blinding white crescent basking two AU's from Epsilon. The captain had pinned down the location of the enemy base from fifty AU's out, and we had jockeyed in on a wide arc, keeping the bulk of the planet between them and us. That didn't mean we were sneaking up on them—quite the contrary; they launched three abortive attacks—but it put us in a stronger defensive position. Until we had to go to the surface, that is. Then only the ship and its Star Fleet crew would be reasonably safe.

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Since the planet rotated rather slowly—once every ten and one half days—a "stationary" orbit for the ship had to be one hundred fifty thousand clicks out. This made the people in the ship feel quite secure, with six thousand miles of rock and ninety thousand miles of space between them and the enemy. But it meant a whole second's time lag in communication between us on the ground and the ship's battle computer. A person could get awful dead while that neutrino pulse crawled up and back.

Our vague orders were to attack the base and gain control while damaging a minimum of enemy equipment. We were to take at least one enemy alive. We were under no circumstances to allow *ourselves* to be taken alive, however. And the decision wasn't up to us; one special pulse from the battle computer and that speck of plutonium in your power plant would fission with all of .01% efficiency, and you'd be nothing but a rapidly expanding, very hot plasma.

They strapped us into six scoutships—one platoon of twelve people in each—and we blasted away from *Earth's Hope* at 8 Gs. Each scoutship was supposed to follow its own carefully random path to our rendezvous point, one hundred eight clicks from the base. Fourteen drone ships were launched at the same time, to confound the enemy's anti-spacecraft system.

The landing went off almost perfectly. One ship suffered minor damage, a near miss boiling away some of the ablative material on one side of the hull, but it'd still be able to make it and return, as long as it kept its speed down while in the atmosphere.

We zigged and zagged and wound up first ship at the rendezvous point. There was only one trouble. It was under four kilometers of water.

I could almost hear that machine, ninety thousand miles away, grinding its mental gears, adding this new bit of data. We proceeded just as if we were landing on solid ground: braking rockets, falling, skids out, hit the water, skip, hit the water, skip, hit the water, sink.

It would have made sense to go ahead and land on the bottom—we were streamlined, after all, and water just another fluid—but the hull wasn't strong enough to hold up a four-kilometer column of water. Sergeant Cortez was in the scoutship with us.

"Sarge, tell that computer to *do* something! We're gonna get—"

"Oh, shut up, Mandella. Trust in th' lord." "Lord" was definitely lower-case when Cortez said it.

There was a loud bubbly sigh, then another and a slight increase in pressure on my back that meant the ship was rising. "Flotation bags?" Cortez didn't deign to answer, or didn't know.

That must have been it. We rose to within ten or fifteen meters of the surface and stopped, suspended

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there. Through the port I could see the surface above, shimmering like a mirror of hammered silver. I wondered what it could be like, to be a fish and have a definite roof over your world.

I watched another ship splash in. It made a great cloud of bubbles and turbulence, then fell—slightly tail-first—for a short distance before large bags popped out under each delta wing. Then it bobbed up to about our level and stayed.

Soon all of the ships were floating within a few hundred meters of us, like a school of ungainly fish.

"This is Captain Stott. Now listen carefully. There is a beach some twenty-eight clicks from your present position, in the direction of the enemy. You will be proceeding to this beach by scoutship and from there will mount your assault on the Tauran position." That was *some* improvement; we'd only have to walk eighty clicks.

We deflated the bags, blasted to the surface and flew in a slow, spread-out formation to the beach. It took several minutes. As the ship scraped to a halt I could hear pumps humming, making the cabin pressure equal to the air pressure outside. Before it had quite stopped moving, the escape slot beside my couch slid open. I rolled out onto the wing of the craft and jumped to the ground. Ten seconds to find cover—I sprinted across loose gravel to the "treeline," a twisty bramble of tall sparse bluish-green shrubs. I dove into the briar path and turned to watch the ships leave. The drones that were left rose slowly to about a hundred meters, then took off in all directions with a bone-jarring roar. The real scoutships slid slowly back into the water. Maybe that was a good idea.

It wasn't a terribly attractive world, but certainly would be easier to get around in than the cryogenic nightmare we were trained for. The sky was a uniform dull silver brightness that merged with the mist over the ocean so completely as to make it impossible to tell where water ended and air began. Small wavelets licked at the black gravel shore, much too slow and graceful in the three-quarters Earth normal gravity. Even from fifty meters away, the rattle of billions of pebbles rolling with the tide was loud in my ears.

The air temperature was 79° Centigrade, not quite hot enough for the sea to boil, even though the air pressure was low compared to Earth's. Wisps of steam drifted quickly upward from the line where water met land. I wondered how long a man would survive, exposed here without a suit. Would the heat or the low oxygen—partial pressure one-eighth Earth normal—kill him first? Or was there some deadly microorganism that would beat them both . . .

"This is Cortez. Everybody come over and assemble by me." He was standing on the beach a little to the left of me, waving his hand in a circle over his head. I walked toward

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him through the shrubs. They were brittle, unsubstantial, seemed paradoxically dried-out in the steamy air. They wouldn't offer much in the way of cover.

"We'll be advancing on a heading .05 radians east of north. I want Platoon One to take point. Two and Three follow about twenty meters behind, to the left and right. Seven, command platoon, is in the middle, twenty meters behind Two and Three. Five and Six, bring up the rear, in a semicircular closed flank. Everybody straight?" Sure, we could do that "arrowhead" maneuver in our sleep. "O.K., let's move out."

I was in Platoon Seven, the "command group." Captain Stott put me there not because I was expected to give any commands, but because of my training in physics.

The command group was supposedly the safest place, buffered by six platoons: people were assigned to it because there was some tactical reason for them to survive at least a little longer than the rest. Cortez was there to give orders. Chavez was there to correct suit malfuncts. The senior medic, Doc Wilson–the only medic who actually had an MD–was there and so was Theodopolis, the radio engineer: our link with the captain, who had elected to stay in orbit.

The rest of us were assigned to the command group by dint of special training or aptitude, that wouldn't normally be considered of a "tactical" nature. Facing a totally unknown enemy, there was no way of telling what might prove important. Thus I was there because I was the closest the company had to a physicist. Rogers was biology. Tate was chemistry. Ho could crank out a perfect score on the Rhine extrasensory perception test, every time. Bohrs was a polyglot, able to speak twenty-one languages fluently, idiomatically. Petrov's talent was that he had tested out to have not one molecule of xenophobia in his psyche. Keating was a skilled acrobat. Debby Hollister–"Lucky" Hollister–showed a remarkable aptitude for making money, and also had a consistently high Rhine potential.

XII

When we first set out, we were using the "jungle" camouflage combination on our suits. But what passed for jungle in these anemic tropics was too sparse; we looked like a band of conspicuous harlequins trooping through the woods. Cortez had us switch to black, but that was just as bad, as the light from Epsilon came evenly from all parts of the sky, and there were no shadows except us. We finally settled on the dun-colored desert camouflage.

The nature of the countryside changed slowly as we walked north, away from the sea. The throned stalks, I guess you could call them trees, came in fewer numbers but were bigger around and less brittle; at the base of each was a tangled

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mass of vine with the same blue-green color, which spread out in a flattened cone some ten meters in diameter. There was a delicate green flower the size of a man's head near the top of each tree.

Grass began to appear some five clicks from the sea. It seemed to respect the trees' "property rights"; leaving a strip of bare earth around each cone of vine. At the edge of such a clearing, it would grow as timid blue-green stubble; then, moving away from the tree, would get thicker and taller until it reached shoulder-high in some places, where the separation between two trees was unusually large. The grass was a lighter, greener shade than the trees and vines. We changed the color of our suits to the bright green we had used for maximum visibility on Charon. Keeping to the thickest part of the grass, we were fairly inconspicuous.

I couldn't help thinking that one week of training in a South American jungle would have been worth a hell of a lot more than all those weeks on Charon. We wouldn't be so understrength, either.

We covered over twenty clicks each day, buoyant after months under 2 Gs. Until the second day, the only form of animal life we saw was a kind of black worm, finger-sized with hundreds of cilium legs like the bristles of a stiff brush. Rogers said that there obviously had to be some sort of larger creature around, or there would be no reason for the trees to have thorns. So we were doubly on guard, expecting trouble both from the Taurans and the unidentified "large creatures."

Potter's Second Platoon was on point; the general freak was reserved for her, since point would likely be the First Platoon to spot any trouble.

"Sarge, this is Potter," we all heard. "Movement ahead."

"Get down then!"

"We are. Don't think they see us."

"First Platoon, go up to the right of point. Keep down. Fourth, get up to the left. Tell me when you get in position. Sixth Platoon, stay back and guard the rear. Fifth and Third, close with the command group."

Two dozen people whispered out of the grass, to join us. Cortez must have heard from the Fourth Platoon.

"Good. How about you, First . . . O.K., fine. How many are there?"

"Eight we can see." Potter's voice.

"Good. When I give the word, open fire. Shoot to kill."

"Sarge . . . they're just animals."

"Potter—if you've known all this time what a Tauran looks like, you should've told us. Shoot to kill."

"But we need . . ."

"We need a prisoner, but we don't need to escort him forty clicks to his home base and keep an eye on him while we fight. Clear?"

"Yes. Sergeant."

"O.K. Seventh, all you brains and weirds, we're going up and watch. Fifth and Third, come along to guard."

We crawled through the meter-

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high grass to where the Second Platoon had stretched out in a firing line.

"I don't see anything," Cortez said.

"Ahead and just to the left. Dark green."

They were only a shade darker than the grass. But after you saw the first one, you could see them all, moving slowly around some thirty meters ahead.

"Fire!" Cortez fired first, then twelve streaks of crimson leaped out and the grass wilted back, disappeared and the creatures convulsed and died trying to scatter.

"Hold fire, hold it!" Cortez stood up. "We want to have something left—Second Platoon, follow me." He strode out toward the smoldering corpses, laser finger pointed out front, obscene divining rod pulling him toward the carnage . . . I felt my gorge rising and knew that all the lurid training tapes, all the horrible deaths in training accidents, hadn't prepared me for this sudden reality . . . that I had a magic wand that I could point at a life and make it a smoking piece of half-raw meat; I wasn't a soldier nor ever wanted to be one nor ever would want—

"O.K., Seventh, come on up."

While we were walking toward them, one of the creatures moved, a tiny shudder, and Cortez flicked the beam of his laser over it with an almost negligent gesture. It made a hand-deep gash across the creature's middle. It died, like the others, without emitting a sound.

They were not quite as tall as humans, but wider in girth. They were covered with dark green, almost black fur; white curls where the laser had singed. They appeared to have three legs and an arm. The only ornament to their shaggy heads was a mouth, wet black orifice filled with flat black teeth. They were thoroughly repulsive but their worst feature was not a difference from human beings but a similarity . . . wherever the laser had opened a body cavity, milk-white glistening veined globes and coils of organs spilled out, and their blood was dark clotting red.

"Rogers, take a look. Taurans or not?"

Rogers knelt by one of the disemboweled creatures and opened a flat plastic box, filled with glittering dissecting tools. She selected a scalpel. "One way we might be able to find out." Doc Wilson watched over her shoulder as she methodically slit the membrane covering several organs.

"Here." She held up a blackish fibrous mass between two fingers, parody of daintiness through all that armor.

"So?"

"It's grass, Sergeant. If the Taurans can eat the grass and breathe the air, they certainly found a planet remarkably like their home." She tossed it away. "They're animals, Sergeant, just damn animals."

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"I don't know," Doc Wilson said. "Just because they walk around on all fours, threes maybe, and are able to eat grass . . ."

"Well, let's check out the brain." She found one that had been hit in the head and scraped the superficial black char from the wound. "Look at that."

It was almost solid bone. She tugged and ruffled the hair all over the head of another one. "What the hell does it use for sensory organs? No eyes, or ears, or . . ." She stood up. "Nothing in that head but a mouth and ten centimeters of skull. To protect nothing, not a damn thing."

"If I could shrug, I'd shrug," the doctor said. "It doesn't prove anything—a brain doesn't have to look like a mushy walnut and it doesn't have to be in the head. Maybe that skull isn't bone, maybe *that's* the brain, some crystal lattice . . ."

"Yeah, but the stomach's in the right place, and if those aren't intestines I'll eat—"

"Look," Cortez said, "this is all real interesting, but all we need to know is whether that thing's dangerous, then we've gotta move on, we don't have all—"

"They aren't dangerous," Rogers began. They don't—"

"Medic! DOC!" Somebody was waving his arms, back at the firing line. Doc sprinted back to him, the rest of us following.

"What's wrong?" He had reached back and unclipped his medical kit on the run.

"It's Ho, she's out."

Doc swung open the door on Ho's biomedical monitor. He didn't have to look far. "She's dead."

"Dead?" Cortez said. "What the hell—"

"Just a minute." Doc plugged a jack into the monitor and fiddled with some dials on his kit. "Everybody's biomed readout is stored for twelve hours. I'm running it backwards, should be able to—there!"

"What?"

"Four and a half minutes ago—must have been when you opened fire—"

"Well?"

"Massive cerebral hemorrhage. No . . ." he watched the dials. "No . . . warning, no indication of anything out of the ordinary; blood pressure up, pulse up, but normal under the circumstances . . . nothing to . . . indicate—" He reached down and popped her suit. Her fine oriental features were distorted in a horrible grimace, both gums showing. Sticky fluid ran from under her collapsed eyelids and a trickle of blood still dripped from each ear. Doc Wilson closed the suit back up.

"I've never seen anything like it. It's as if a bomb went off in her skull."

"Oh crap," Rogers said, "she was Rhine-sensitive, wasn't she."

"That's right." Cortez sounded thoughtful. "All right, everybody listen. Platoon leaders, check your pla-

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toons and see if anybody's missing, or hurt. Anybody else in Seventh?"

"I . . . I've got a splitting headache, Sarge," Lucky said.

Four others had bad headaches. One of them affirmed that he was slightly Rhine-sensitive. The others didn't know.

"Cortez, I think it's obvious," Doc Wilson said, "that we should give these . . . monsters wide berth, especially shouldn't harm any more of them. Not with five people susceptible to whatever apparently killed Ho."

"Of course, damn it, I don't need anybody to tell me that. We'd better get moving. I just filled the captain in on what happened; he agrees that we'd better get as far away from here as we can, before we stop for the night.

"Let's get back in formation and continue on the same bearing. Fifth Platoon, take over point; Second, come back to the rear. Everybody else, same as before."

"What about Ho?" Lucky asked.

"She'll be taken care of. From the ship."

After we'd gone half a click, there was a flash and rolling thunder. Where Ho had been, came a wispy luminous mushroom cloud boiling up to disappear against the gray sky.

XIII

We stopped for the "night"—actually, the sun wouldn't set for another seventy hours—atop a slight rise some ten clicks from where we had killed the aliens. But they weren't aliens, I had to remind myself—*we* were.

Two platoons deployed in a ring around the rest of us, and we flopped down exhausted. Everybody was allowed four hours' sleep and had two hours' guard duty.

Potter came over and sat next to me. I chinned her frequency.

"Hi, Marygay."

"Oh, William," her voice over the radio was hoarse and cracking. "God, it's so horrible."

"It's over now—"

"I killed one of them, the first instant, I shot it right in the, in the—"

I put my hand on her knee. The contact made a plastic click and I jerked it back, visions of machines embracing, copulating. "Don't feel singled out, Marygay, whatever guilt there is, belongs evenly to all of us . . . but a triple portion for Cor—"

"You privates quit jawin' and get some sleep. You both pull guard in two hours."

"O.K., Sarge." Her voice was so sad and tired I couldn't bear it, I felt if I could only touch her I could drain off the sadness like a ground wire draining current but we were each trapped in our own plastic world.

"G'night, William."

"Night." It's almost impossible to get sexually excited inside a suit, with the relief tube and all the silver chloride sensors poking you, but somehow this was my body's re-

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sponse to the emotional impotence, maybe remembering more pleasant sleeps with Marygay, maybe feeling that in the midst of all this death, personal death could be soon, cranking up the procreative derrick for one last try . . . lovely thoughts like this and I fell asleep and dreamed that I was a machine, mimicking the functions of life, creaking and clanking my clumsy way through the world, people too polite to say anything but giggling behind my back, and the little man who sat inside my head pulling the levers and clutches and watching the dials, he was hopelessly mad and was storing up hurts for the day—

"Mandella—wake up, damn it, your shift!"

I shuffled over to my place on the perimeter to watch for God knows what . . . but I was so weary I couldn't keep my eyes open. Finally I tongued a stimtab, knowing I'd pay for it later.

For over an hour I sat there, scanning my sector left, right, near, far; the scene never changing, not even a breath of wind to stir the grass.

Then suddenly the grass parted and one of the three-legged creatures was right in front of me. I raised my finger but didn't squeeze.

"Movement!"

"Movement!"

"HOLD YOUR FIRE. Don't shoot!"

"Movement."

"Movement." I looked left and right and as far as I could see, every perimeter guard had one of the blind dumb creatures standing right in front of him.

Maybe the drug I'd taken to stay awake made me more sensitive to whatever they did. My scalp crawled and I felt a formless *thing* in my mind, the feeling you get when somebody has said something and you didn't quite hear it, want to respond but the opportunity to ask him to repeat it is gone.

The creature sat back on its haunches, leaning forward on the one front leg. Big green bear with a withered arm. Its power threaded through my mind, spiderwebs, echo of night terrors, trying to communicate, trying to destroy me, I couldn't know.

"All right, everybody on the perimeter, fall back, slow. Don't make any quick gestures . . . anybody got a headache or anything?"

"Sergeant, this is Hollister." Lucky.

"They're trying to say something . . . I can almost . . . no, just—"

"Well?"

"All I can get is that they think we're, . . . think we're . . . well, *funny*. They aren't afraid."

"You mean the one in front of you isn't—"

"No, the feeling comes from all of them, they're all thinking the same thing. Don't ask me how I know, I just do."

"Maybe they thought it was funny, what they did to Ho."

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"Maybe. I don't feel like they're dangerous. Just curious about us."

"Sergeant, this is Bohrs."

"Yeah."

"The Taurans have been here at least a year—maybe they've learned how to communicate with these . . . overgrown teddy bears. They might be spying on us, might be sending back—"

"I don't think they'd show themselves, if that were the case," Lucky said. "They can obviously hide from us pretty well when they want to."

"Anyhow," Cortez said, "if they're spies, the damage has been done. Don't think it'd be smart to take any action against them. I know you'd all like to see 'em dead for what they did to Ho, so would I, but we'd better be careful."

I didn't want to see them dead, but I'd just as soon not see them in any condition. I was walking backwards slowly, toward the middle of camp. The creature didn't seem disposed to follow. Maybe he just knew we were surrounded. He was pulling up grass with his arm and munching.

"O.K., all of you platoon leaders, wake everybody up, get a roll count. Let me know if anybody's been hurt. Tell your people we're moving out in one minute."

I don't know what Cortez expected, but of course the creatures just followed right along. They didn't keep us surrounded; just had twenty or thirty following us all the time. Not the same ones, either. Individuals would saunter away, new ones would join the parade. It was pretty obvious that *they* weren't going to tire out.

We were each allowed one stimtab. Without it, no one could have marched an hour. A second pill would have been welcome after the edge started to wear off, but the mathematics of the situation forbade it: we were still thirty clicks from the enemy base; fifteen hours' marching at the least. And though one could stay awake and energetic for a hundred hours on the 'tabs, aberrations of judgment and perception snowballed after the second 'tab, until *in extremis* the most bizarre hallucinations would be taken at face value, and a person would fidget for hours, deciding whether to have breakfast.

Under artificial stimulation, the company traveled with great energy for the first six hours, was slowing by the seventh, and ground to an exhausted halt after nine hours and nineteen kilometers. The teddybears had never lost sight of us and, according to Lucky, had never stopped "broadcasting." Cortez's decision was that we would stop for seven hours, each platoon taking one hour of perimeter guard. I was never so glad to have been in the Seventh Platoon, as we stood guard the last shift and thus were the only ones to get six hours of uninterrupted sleep.

In the few moments I lay awake after finally lying down, the thought came to me that the next time I closed my eyes could well be the last. And partly because of the drug

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hangover, mostly because of the past day's horrors, I found that I really just didn't give a damn.

XIV

Our first contact with the Taurans came during my shift.

The teddybears were still there when I woke up and replaced Doc Jones on guard. They'd gone back to their original formation, one in front of each guard position. The one who was waiting for me seemed a little larger than normal, but otherwise looked just like all the others. All the grass had been cropped where he was sitting, so he occasionally made forays to the left or right. But he always returned to sit right in front of me, you would say staring if he had had anything to stare with.

We had been facing each other for about fifteen minutes when Cortez's voice rumbled:

"Awright everybody wake up and get hid!"

I followed instinct and flopped to the ground and rolled into a tall stand of grass.

"Enemy vessel overhead." His voice was almost laconic.

Strictly speaking, it wasn't really overhead, but rather passing somewhat east of us. It was moving slowly, maybe a hundred clicks per hour, and looked like a broomstick surrounded by a dirty soap bubble. The creature riding it was a little more human-looking than the teddybears, but still no prize. I cranked my image amplifier up to forty log two for a closer look.

He had two arms and two legs, but his waist was so small you could encompass it with both hands. Under the tiny waist was a large horseshoe-shaped pelvic structure nearly a meter wide, from which dangled two long skinny legs with no apparent knee joint. Above that waist his body swelled out again, to a chest no smaller than the huge pelvis. His arms looked surprisingly human, except that they were too long and undermuscled. There were too many fingers on his hands. Shoulderless, neckless; his head was a nightmarish growth that swelled like a goiter from his massive chest. Two eyes that looked like clusters of fish eggs, a bundle of tassles instead of a nose, and a rigidly open hole that might have been a mouth sitting low down where his Adam's apple should have been. Evidently the soap bubble contained an amenable environment, as he was wearing absolutely nothing except a ridged hide that looked like skin submerged too long in hot water, then dyed a pale orange. "He" had no external genitalia, nor anything that might hint of mammary glands.

Obviously, he either didn't see us, or thought we were part of the herd of teddybears. He never looked back at us, but just continued in the same direction we were headed, .05 rad east of north.

"Might as well go back to sleep now, if you can sleep after looking at

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that thing. We move out at 0435." Forty minutes.

Because of the planet's opaque cloud cover, there had been no way to tell, from space, what the enemy base looked like or how big it was. We only knew its position, the same way we knew the position the scoutships were supposed to land on. So it could easily have been underwater too, or underground.

But some of the drones were reconnaissance ships as well as decoys; and in their mock attacks on the base, one managed to get close enough to take a picture. Captain Stott beamed down a diagram of the place to Cortez—the only one with a visor in his suit—when we were five clicks from the base's "radio" position. We stopped and he called all of the platoon leaders in with the Seventh Platoon to confer. Two teddybears loped in, too. We tried to ignore them.

"O.K., the captain sent down some pictures of our objective. I'm going to draw a map; you platoon leaders copy." They took pads and styli out of their leg pockets, while Cortez unrolled a large plastic mat. He gave it a shake to randomize any residual charge, and turned on his stylus.

"Now, we're coming from this direction." He put an arrow at the bottom of the sheet. "First thing we'll hit is this row of huts, probably billets, or bunkers, but who the hell knows . . . our initial objective is to destroy these buildings—the whole base is on a flat plain; there's no way we could really sneak by them."

"Potter here. Why can't we jump over them?"

"Yeah, we could do that, and wind up completely surrounded, cut to ribbons. We take the buildings.

"After we do that . . . all I can say is that we'll have to think on our feet. From the aerial reconnaissance, we can figure out the function of only a couple of buildings—and that stinks. We might wind up wasting a lot of time demolishing the equivalent of an enlisted man's bar, ignoring a huge logistic computer because it looks like . . . a garbage dump or something."

"Mandella here," I said. "Isn't there a spaceport of some kind—seems to me we ought to . . ."

"I'll *get* to that, damn it. There's a ring of these huts all around the camp, so we've got to break through somewhere. This place'll be closest, less chance of giving away our position before we attack.

"There's nothing in the whole place that actually looks like a weapon. That doesn't mean anything, though; you could hide a bevawatt laser in each of those huts.

"Now, about five hundred meters from the huts, in the middle of the base, we'll come to this big flower-shaped structure." Cortez drew a large symmetrical shape that looked like the outline of a flower with seven petals. "What the hell this is, your guess is as good as mine. There's only one of them, though, so

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we don't damage it any more than we have to. Which means . . . we blast it to splinters if I think it's dangerous.

"Now, as far as your spaceport, Mandella, is concerned—there just isn't one. Nothing.

"That cruiser the *Hope* caulked had probably been left in orbit, like ours has to be. If they have any equivalent of a scoutship, or drone missiles, they're either not kept here or they're well hidden."

"Bohrs here. Then what did they attack with, while we were coming down from orbit?"

"I wish we knew, Private.

"Obviously, we don't have any way of estimating their numbers, not directly. Recon pictures failed to show a single Tauran on the grounds of the base. Meaning nothing, because it *is* an alien environment. Indirectly, though . . . we can count the number of broomsticks.

"There are fifty-one huts, and each has at most one broomstick. Four don't have one parked outside, but we located three at various other parts of the base. Maybe this indicates that there are fifty-one Taurans, one of whom was outside the base when the picture was taken."

"Keating here. Or fifty-one officers."

"That's right—maybe fifty thousand infantrymen stacked in one of these buildings. No way to tell. Maybe ten Taurans, each with five broomsticks, to use according to his mood.

"We've got one thing in our favor, and that's communications. They evidently use a frequency modulation of megahertz electromagnetic radiation."

"Radio!"

"That's right, whoever you are. Identify yourself when you speak. So, it's quite possible that they can't detect our phased-neutrino communications. Also, just prior to the attack, the *Hope* is going to deliver a nice dirty fission bomb; detonate it in the upper atmosphere right over the base. That'll restrict them to line-of-sight communications for some time; even those will be full of static."

"Why don't . . . Tate here . . . why don't they just drop the bomb right in their laps? Would save us a lot of—"

"That doesn't even deserve an answer, Private. But the answer is, they might. And you better hope they don't. If they caulk the base, it'll be for the safety of the *Hope*. *After* we've attacked, and probably before we're far enough away for it to make much difference.

"We keep that from happening by doing a good job. We have to reduce the base to where it can no longer function; at the same time, leave as much intact as possible. And take one prisoner."

"Potter here. You mean, at least one prisoner."

"I mean what I say. One only. Potter . . . you're relieved of your platoon. Send Chavez up."

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"All right, Sergeant." The relief in her voice was unmistakable.

Cortez continued with his map and instructions. There was one other building whose function was pretty obvious; it had a large steerable dish antenna on top. We were to destroy it as soon as the grenadiers got in range.

The attack plan was very loose. Our signal to begin would be the flash of the fission bomb. At the same time, several drones would converge on the base, so we could see what their antispacecraft defenses were. We would try to reduce the effectiveness of those defenses without destroying them completely.

Immediately after the bomb and the drones, the grenadiers would vaporize a line of seven huts. Everybody would break through the hole into the base . . . and what would happen after that was anybody's guess.

Ideally, we'd sweep from that end of the base to the other, destroying certain targets, caulking all but one Tauran. But that was unlikely to happen, as it depended on the Taurans' offering very little resistance.

On the other hand, if the Taurans showed obvious superiority from the beginning, Cortez would give the order to scatter: everybody had a different compass bearing for retreat—we'd blossom out in all directions, the survivors to rendezvous in a valley some forty clicks east of the base. Then we'd see about a return engagement, after the *Hope* softened the base up a bit.

"One last thing," Cortez rasped. "Maybe some of you feel the way Potter evidently does, maybe some of your men feel that way . . . that we ought to go easy, not make this so much of a bloodbath. Mercy is a luxury, a weakness we can't afford to indulge in at this stage of the war. *All* we know about the enemy is that they have killed seven hundred and ninety-eight humans. They haven't shown any restraint in attacking our cruisers, and it'd be foolish to expect any this time, this first ground action.

"*They* are responsible for the lives of all of your comrades who died in training, and for Ho, and for all the others who are surely going to die today. I can't *understand* anybody who wants to spare them. But that doesn't make any difference. You have your orders, and what the hell, you might as well know, all of you have a posthypnotic suggestion that I will trigger by a phrase, just before the battle. It will make your job easier."

"Sergeant . . ."

"Shut up. We're short on time; get back to your platoons and brief them. We move out in five minutes."

The platoon leaders returned to their men, leaving Cortez and the ten of us, plus three teddybears, milling around, getting in the way.

XV

We took the last five clicks very carefully, sticking to the highest

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grass, running across occasional clearings. When we were five hundred meters from where the base was supposed to be, Cortez took the Third Platoon forward to scout, while the rest of us laid low.

Cortez's voice came over the general freak: "Looks pretty much like we expected. Advance in a file, crawling. When you get to the Third Platoon, follow your squad leader to the left, or right."

We did that and wound up with a string of eighty-three people in a line roughly perpendicular to the direction of attack. We were pretty well hidden, except for the dozen or so teddybears that mooched along the line munching grass.

There was no sign of life inside the base. All of the buildings were windowless, and a uniform shiny white. The huts that were our first objective were large featureless half-buried eggs, some sixty meters apart. Cortez assigned one to each grenadier.

We were broken into three fire teams: Team A consisted of platoons Two, Four, and Six; Team B was One, Three, and Five; the command platoon was Team C.

"Less than a minute now—filters down!—when I say 'fire', grenadiers take out your targets. God help you if you miss."

There was a sound like a giant's belch and a stream of five or six iridescent bubbles floated up from the flower-shaped building. They rose with increasing speed to where they were almost out of sight, then shot off to the south, over our heads. The ground was suddenly bright and for the first time in a long time, I saw my shadow, a long one pointed north. The bomb had gone off prematurely. I just had time to think that it didn't make too much difference; it'd still make alphabet soup out of their communications—

"Drones!" A ship came screaming in just above tree level, and a bubble was in the air to meet it. When they contacted, the bubble popped and the drone exploded into a million tiny fragments. Another one came from the opposite side and suffered the same fate.

"FIRE!" Seven bright glares of 500-microton grenades and a sustained concussion that I'm sure would have killed an unprotected man.

"Filters up." Gray haze of smoke and dust. Clods of dirt falling with a sound like heavy raindrops.

"Listen up:

" 'Scots, wha hae wi' Wallace bled;
Scots, wham Bruce has aften led,
Welcome to your gory bed,
Or to victory!' "

I hardly heard him, for trying to keep track of what was going on in my skull. I knew it was just post-hypnotic suggestion, even remembered the session in Missouri when they'd implanted it, but that didn't make it any less compelling. My mind reeled under the strong pseudo-memories; shaggy hulks that were Taurans—not at all what we now knew they looked like—board-

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ing a colonist's vessel, eating babies while mothers watched in screaming terror—the colonists never took babies; they wouldn't stand the acceleration—then raping the women to death with huge veined purple members—ridiculous that they would feel desire for humans—holding the men down while they plucked flesh from their living bodies and gobbled it . . . a hundred grisly details as sharply remembered as the events of a minute ago, ridiculously overdone and logically absurd; but while my conscious mind was refecting the silliness, somewhere much deeper, down in that sleeping giant where we keep our real motives and morals, something was thirsting for alien blood, secure in the conviction that the noblest thing a man could do would be to die killing one of those horrible monsters . . .

I knew it was all purest soya, and I hated the men who had taken such obscene liberties with my mind, but still I could hear my teeth grinding, feel cheeks frozen in a spastic grin, bloodlust . . . a teddybear walked in front of me, looking dazed. I started to raise my laserfinger, but somebody beat me to it and the creature's head exploded in a cloud of gray splinters and blood.

Lucky groaned, half-whining, "Dirty . . . filthy bastards." Lasers flared and crisscrossed and all of the teddybears fell dead.

"*Watch* it, damn it," Cortez screamed. "*Aim* those things they aren't toys!

"Team A, move out—into the craters to cover B."

Somebody was laughing and sobbing. "What the crap is wrong with *you,* Petrov?" First time I could remember Cortez cussing.

I twisted around and saw Petrov, behind and to my left, lying in a shallow hole, digging frantically with both hands, crying and gurgling.

"Crap," Cortez said. "Team B! past the craters ten meters, get down in a line. Team C—into the craters with A."

I scrambled up and covered the hundred meters in twelve amplified strides. The craters were practically large enough to hide a scoutship, some ten meters in diameter. I jumped to the opposite side of the hole and landed next to a fellow named Chin. He didn't even look around when I landed, just kept scanning the base for signs of life.

"Team A—past Team B ten meters, down in line." Just as he finished, the building in front of us burped and a salvo of the bubbles fanned out toward our lines. Most people saw it coming and got down, but Chin was just getting up to make his rush and stepped right into one.

It grazed the top of his helmet, and disappeared with a faint pop. He took one step backwards and toppled over the edge of the crater, trailing an arc of blood and brains. Lifeless, spreadeagled, he slid halfway to the bottom, shoveling dirt into the perfectly symmetrical hole

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where the bubble had chewed through plastic, hair, skin, bone and brain indiscriminately.

"Everybody hold it. Platoon leaders, casualty report . . . check . . . check, check . . . check, check, check . . . check. We have three deaders. Wouldn't be *any* if you'd have kept low. So everybody grab dirt when you hear that thing go off. Team A, complete the rush."

They completed the maneuver without incident. "O.K. Team C, rush to where B . . . hold it! Down!"

Everybody was already hugging the ground. The bubbles slid by in a smooth arc about two meters off the ground. They went serenely over our heads and, except for one that made toothpicks out of a tree, disappeared in the distance.

"B, rush past A ten meters. C, take over B's place. You B grenadiers see if you can reach the Flower."

Two grenades tore up the ground thirty or forty meters from the structure. In a good imitation of panic, it started belching out a continuous stream of bubbles—still, none coming lower than two meters off the ground. We kept hunched down and continued to advance.

Suddenly, a seam appeared in the building, widened to the size of a large door, and Taurans came swarming out.

"Grenadiers, hold your fire. B team, laser fire to the left and right, keep'em bunched up. A and C, rush down the center."

One Tauran died trying to run through a laser beam. The others stayed where they were.

In a suit, it's pretty awkward to run and try to keep your head down, at the same time. You have to go from side to side, like a skater getting started; otherwise you'll be airborne. At least one person, somebody in A team, bounced too high and suffered the same fate as Chin.

I was feeling pretty fenced-in and trapped, with a wall of laser fire on each side and a low ceiling that meant death to touch. But in spite of myself, I felt happy, euphoric at finally getting the chance to kill some of those villainous baby-eaters.

They weren't fighting back, except for the rather ineffective bubbles—obviously not designed as an anti-personnel weapon—and they didn't retreat back into the building, either. They just milled around, about a hundred of them, and watched us get closer. A couple of grenades would caulk them all, but I guess Cortez was thinking about the prisoner.

"O.K., when I say 'go', we're going to flank 'em. B team will hold fire . . . Second and Fourth to the right, Sixth and Seventh to the left. B team will move forward in line to box them in.

"Go!" We peeled off to the left. As soon as the lasers stopped, the Taurans bolted, running in a group on a collision course with our flank.

"A Team, down and fire! Don't shoot until you're sure of your aim—if you miss you might hit a friendly. And fer Chris'sake save me one!"

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It was a horrifying sight, that herd of monsters bearing down on us. They were running in great leaps—the bubbles avoiding them—and they all looked like the one we saw earlier, riding the broomstick; naked except for an almost transparent sphere around their whole bodies, that moved along with them. The right flank started firing, picking off individuals in the rear of the pack.

Suddenly a laser flared through the Taurans from the other side, somebody missing his mark. There was a horrible scream and I looked down the line to see someone, I think it was Perry, writhing on the ground, right hand over the smoldering stump of his left arm, seared off just below the elbow. Blood sprayed through his fingers and the suit, it's camouflage circuits scrambled, flickered black-white-jungle-desert-green-gray. I don't know how long I stared—long enough for the medic to run over and start giving aid—but when I looked up the Taurans were almost on top of me.

My first shot was wild and high, but it grazed the top of the leading Tauran's protective bubble. The bubble disappeared and the monster stumbled and fell to the ground, jerking spasmodically. Foam gushed out of his mouth-hole, first white, then streaked with red. With one last jerk he became rigid and twisted backwards, almost to the shape of a horseshoe. His long scream, a high-pitched whistle, stopped just as his comrades trampled over him and I hated myself for smiling.

It was slaughter, even though our flank was outnumbered five to one. They kept coming without faltering, even when they had to climb over the drift of bodies and parts of bodies that piled up high, parallel to our flank. The ground between us was slick red with Tauran blood—all God's children got hemoglobin—and, like the teddybears, their guts looked pretty much like guts to my untrained eye. My helmet reverberated with hysterical laughter while we cut them to gory chunks. I almost didn't hear Cortez.

"Hold your fire—I said HOLD IT damn it! *Catch* a couple of the bastards, they won't hurt you."

I stopped shooting and eventually so did everybody else. When the next Tauran jumped over the smoking pile of meat in front of me, I dove to try to tackle him around those spindly legs.

It was like hugging a big, slippery balloon. When I tried to drag him down, he just popped out of my arms and kept running.

We managed to stop one of them by the simple expedient of piling half-a-dozen people on top of him. By that time the others had run through our line and were headed for the row of large cylindrical tanks that Cortez had said were probably for storage. A little door had opened in the base of each one.

"We've *got* our prisoner," Cortez shouted. "*Kill*!"

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They were fifty meters away and running hard, difficult targets. Lasers slashed around them, bobbing high and low. One fell, sliced in two, but the others, about ten of them, kept going and were almost to the doors when the grenadiers started firing.

They were still loaded with 500-mike bombs, but a near miss wasn't enough—the concussion would just send them flying, unhurt in their bubbles.

"The buildings! Get the damn buildings!" The grenadiers raised their aim and let fly, but the bombs only seemed to scorch the white outside of the structures until, by chance, one landed in a door. That split the building just as if it had a seam; the two halves popped away and a cloud of machinery flew into the air, accompanied by a huge pale flame that rolled up and disappeared in an instant. Then the others all concentrated on the doors, except for potshots at some of the Taurans; not so much to get them as to blow them away before they could get inside. They seemed awfully eager.

All this time, we were trying to get the Taurans with laser fire, while they weaved and bounced around trying to get into the structures. We moved in as close to them as we could without putting ourselves in danger from the grenade blasts—that was still too far away for good aim.

Still, we were getting them one by one, and managed to destroy four of the seven buildings. Then, when there were only two aliens left, a nearby grenade blast flung one of them to within a few meters of a door. He dove in and several grenadiers fired salvos after him, but they all fell short, or detonated harmlessly on the side. Bombs were falling all around, making an awful racket, but the sound was suddenly drowned out by a great sigh, like a giant's intake of breath, and where the building had been was a thick cylindrical cloud of smoke, solid-looking, dwindling away into the stratosphere, straight as if laid down by a ruler. The other Tauran had been right at the base of the cylinder; I could see pieces of him flying. A second later, a shock wave hit us and I rolled helplessly, pinwheeling, to smash into the pile of Tauran bodies and roll beyond.

I picked myself up and panicked for a second when I saw there was blood all over my suit—when I realized it was only alien blood, I relaxed but felt unclean.

"*Catch* the bastard! Catch him!" In the confusion, the Tauran—now the only one left alive—had got free and was running for the grass. One platoon was chasing after him, losing ground, but then all of B Team ran over and cut him off. I jogged over to join in the fun.

There were four people on top of him, and fifty people watching.

"Spread out, damn it! There might be a thousand more of them waiting to get us in one place." We dispersed, grumbling. By unspoken

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agreement we were all sure that there were no more live Taurans on the face of the planet.

Cortez was walking toward the prisoner while I backed away. Suddenly the four men collapsed in a pile on top of the creature . . . even from my distance I could see the foam spouting from his mouth-hole. His bubble had popped. Suicide.

"Damn!" Cortez was right there. "Get off that bastard." The four men got off and Cortez used his laser to slice the monster into a dozen quivering chunks. Heartwarming sight.

"That's all right, though, we'll find another one—everybody! Back in the arrowhead formation. Combat assault, on the Flower."

Well, we assaulted the Flower, which had evidently run out of ammunition—it was still belching, but no bubbles—and it was empty. We just scurried up ramps and through corridors, fingers at the ready, like kids playing soldier. There was nobody home.

The same lack of response at the antenna installation, the "Salami," and twenty other major buildings, as well as the forty-four perimeter huts still intact. So we had "captured" dozens of buildings, mostly of incomprehensible purpose, but failed in our main mission; capturing a Tauran for the xenologists to experiment with. Oh well, they could have all the bits and pieces of the creatures they'd ever want. That was something.

After we'd combed every last square centimeter of the base, a scoutship came in with the real exploration crew, Star Fleet scientists. Cortez said, "All right, snap out of it," and the hypnotic compulsion fell away.

At first it was pretty grim. A lot of the people, like Lucky and Marygay, almost went crazy with the memories of bloody murder multiplied a hundred times. Cortez ordered everybody to take a sed-tab, two for the ones most upset. I took two without being specifically ordered to do so.

Because it *was* murder, unadorned butchery—once we had the antispacecraft weapon doped out, we weren't in any danger. The Taurans didn't seem to have any conception of person-to-person fighting. We just herded them up and slaughtered them, in the first encounter between mankind and another intelligent species. What might have happened if we had sat down and tried to communicate? Maybe it was the second encounter, counting the teddybears. But they got the same treatment.

I spent a long time after that, telling myself over and over that it hadn't been *me* who so gleefully carved up those frightened, stampeding creatures. Back in the Twentieth Century, they established to everybody's satisfaction that "I was just following orders" was an inadequate excuse for inhuman conduct . . . but what can you do when the orders come from deep down in that puppet master of the unconscious?

Worst of all was the feeling that

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perhaps my actions weren't all that inhuman. Ancestors only a few generations back would have done the same thing, even to their fellowmen, without any hypnotic conditioning.

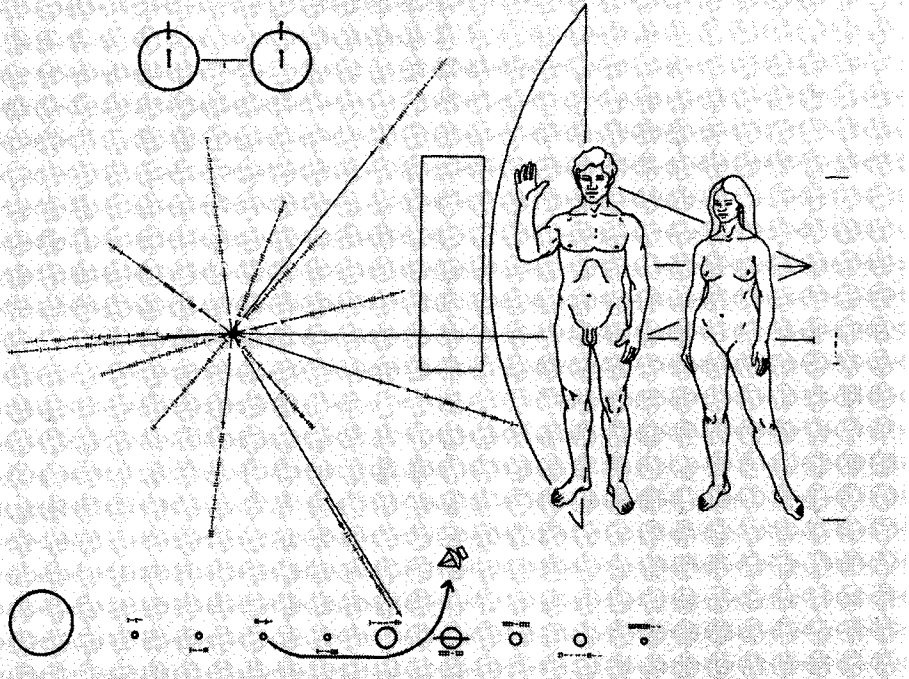
So I was disgusted with the human race, disgusted with the army, and horrified at the prospect of living with myself for another century or so . . . well, there was always brain-wipe.

The ship that the lone Tauran survivor had escaped in had got away, clean, the bulk of the planet shielding it from *Earth's Hope* while it dropped into Aleph's collapsar field. Escaped to home, I guessed, wherever that was, to report what twenty men with hand-weapons could do to a hundred fleeing on foot, unarmed.

I suspected that the next time humans met Taurans in ground combat, we would be more evenly matched. And I was right. ■

• This is the "message from Earth" carried by the Pioneer F spacecraft, launched March 2, 1972. The probe will fly-by Jupiter, then leave the solar system. This pictorial plaque is intended to show any intelligent race that intercepts the spacecraft outside the solar system, who we are and where we come from. But does the picture do the job?

Can you decipher the picture correctly? Or, if you already know what the drawings are supposed to represent, can you figure out an alternate explanation that an intelligent alien might come up with?



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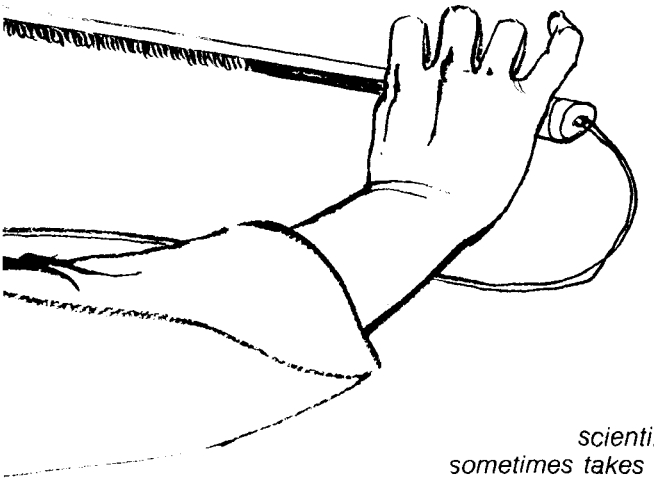
Klysterman's silent violin



The path of scientific research sometimes takes unexpected turns—and so does the path of evolution!

MICHAEL ROGERS

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September 17–

Klysterman is a fool. He is building a silent violin; taking up space in the laboratory, using unrequisitioned materials, interfering with more valuable projects, all to create a violin that will make no sound. He explained it to me this morning: the bow and strings are to be some piezoelectric substance, he claims, that in contacting itself creates not audible vibrations but electrical ones which will be amplified and fed into headphones that the musician will wear. He insisted that he will sell millions of these silent violins, one to every parent whose child is forced to take up the instrument. I told him he was a fool and not to waste my time talking about it. Late this afternoon I saw him wiring a small integrated amplifier. It is difficult to make out what has motivated him to this project but if he is successful I will never hear the end of it.

September 19–

Ludmila W., a young woman who came to the Lab late in the summer, and who is apparently some acquaintance of Klysterman's, gave a short talk at breakfast this morning. She has developed an electrochemical device to create parrot-fever virus from nickel-cadmium cells and carbon tetrachloride. This is the strategic battlefield psittacosis synthesizer that has been predicted for several years. This Ludmila W., although undeniably brilliant, must, I am warned, be watched carefully. For several months she was involved with last year's psilocybin intensification project before it was shut down. She appears to be perfectly normal in every respect, to me at least.

September 20–

On the fourth floor there was another outbreak of the augmented wheat rust this morning. We have emphasized, repeatedly, the necessity of hermetically sealing the *puccinia graminis* spore containers after each working day but mistakes continue to occur. The fool Klysterman was in charge of the carbon dioxide unit that cornered and destroyed the ergot fungus beside the reactor pool. He will undoubtedly get a commendation, ignoring the fact that he released nearly five thousand cubic feet of the gas in fifteen minutes. A child could have done it with less. He is a cretin, Klysterman is, but he has such luck.

September 21–

A surprise this morning. Ludmila W. came to my office a bit before noon asking advice. It was a minor problem but it seems significant that she chose me to visit. She was troubled by extreme thermal run-away in the sustenance modulation circuits of her viral synthesizer. I sketched for her the necessary thermistor modifications and then expressed my polite amazement that she would need help on such a basic and straight-forward matter. It turns out that she is

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not an electronician by education, but a neural paralysis biotist. At one time she worked for a year on the ganglion-destructor toxin at Delta laboratories. She made no mention of the psilocybin intensification project and I was hesitant to bring it up.

I am very much impressed: I had no idea that there was someone of this competence on our staff. She is, as well, an unusually attractive young lady who has not followed the shaven-scalp fashion so popular among the female lab assistants. The effect of hair is truly striking, and easily worth the slight risk of biological contamination. I suspect that she has some interest in me. Perhaps the two of us together can work toward minimizing the massive annoyance of Klysterman here in Beta laboratories. We will, I am certain, get to know one another better.

September 22–

Today Klysterman played his silent violin incessantly. He supports it on his body with thick canvas straps over his shoulders, and insists that it works perfectly but will allow no one else to wear the headphones. I am convinced, for one, that Klysterman is an insane fraud, and it is only a matter of time before he is found out.

At lunch today I sat with Ludmila W. I can detect slight signs, now that I have watched her carefully, of previous involvement with the ill-fated psilocybin intensification project. Several times I clearly noticed her listening to conversations taking place at least two hundred feet away from us, on the other side of the cafeteria. She also stares intently at blank walls, for reasons I have yet to fully understand. After dessert there was a short ceremony presenting Klysterman with a commendation for destroying the augmented wheat rust outbreak, just as I predicted. He accepted it as the frivolous buffoon he has become, grinning and smirking and waving grandly from the podium to individuals in the audience. He waved particularly at Ludmila W., and she waved back, but this, I think, was only politeness on her part.

September 23–

This morning I was transferred up to temporarily supervise the augmented wheat rust project, which has encountered a remarkable turn of events. The wheat rust entered its fourteenth generation today and is now entirely carnivorous. It shows no interest in grains or synthetic protein substitutes. Naturally, we are all concerned. Although there was some slight suspicion that the augmentation might produce an omnivorous fungus, certainly no one ever considered the possibility of a spore-reproducing carnivore.

I think the entire situation may be blamed on modern education. I would wager that the biotechnicians who originally modified the genetic structure of the wheat rust were younger men, trained in method but

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with no sense of craftsmanship. I shudder to imagine those eager overstuffed minds, tearing apart the RNA binders of the wheat rust the way one disassembles the encoder of an infrared spectrometer, with a screwdriver and long-nosed pliers. And, of course, now that they have wreaked their damage they have no idea as to how to set it straight again.

We spent the day examining the genetic profiles for each generation. There appears to be some unprecedented spontaneous evolution taking place between sporings that has no familiar textbook characteristics: a most notable free-form mutation. Klysterman drifted in several times today, with the headphones perched on his huge head, playing his silent violin. It is not altogether silent, I can report with some satisfaction. The piezoelectric materials make a faint scraping noise which I find very annoying. This afternoon Klysterman produced a further consideration to threaten my position when he disconnected himself from his violin long enough to run a future-generational analysis of the wheat rust. The readouts indicate that by the twenty-second, or perhaps twenty-third, generation, the wheat rust may begin to produce activated gaseous lysergic acid derivatives in quantity.

Klysterman immediately suggested that we seal up all the spore cases and ship them to the counter-insurgency hallucinogenic toxin project at Epsilon labs, although he has promised not to make his findings official for several more days. I will not give up the administration of the wheat rust so easily: with sufficient care I think we can produce the strain of augmented ergot that was originally specified in the genetic contract. Klysterman simply wishes to discredit me.

Tonight I went to visit Ludmila W. at her dormitory but she was not in. This is the third evening in a row that she has been gone. Perhaps it is my natural dislike for the man but I cannot help but suspect Klysterman. The two of them associate far too much for Ludmila's best interests, in my view.

September 24—

At my suggestion, Ludmila W. has been temporarily assigned to the augmented wheat rust project. In order to meet the contract deadline someone must devote full time to developing the deployment devices for the new ergot strain.

At present we are considering sound-actuated capsules, perhaps two inches in length, faced with a sensitive audio-range disintegration diaphragm. These would be deployed from high-level aircraft, or upper atmosphere, MIRV targeted over the enemy agricultural center. The capsules would lie dormant in the fields until the slightest sound—the roar of a tractor starting, feet tramping the rows, even loud voices—fractures the diaphragm that holds the ergot spores in place. Once

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fractured, the oxygen in the atmosphere would react with the inner lining of the capsule and ultimately the entire assembly would decompose into the soil.

Ludmila W., although she is less excited about the deployment apparatus than I would like, will undoubtedly complete the assignment competently, giving me the necessary time to restructure the carnivorous wheat rust.

This afternoon the ergot entered its twentieth generation. It now lies in thick yellow-brown slabs in the bottom of the spore container, consuming nearly thirty pounds of raw beef a day. Klysterman suspects that we are starving it, at that; but here there are budgetary considerations to take into account. The most recent projections leave little doubt now that the ergot will begin to actively produce lysergic acid in several generations. Klysterman is threatening to make a full report on this matter tomorrow. This supra-paranoia on his part is not becoming of a scientist: his unwarranted caution, I think, is in reality a desire to see me fail.

September 25–

It is hard to know what to do with an annoyance like Klysterman. Today he came into the augumented wheat rust lab several times, I suspect, simply to make me nervous. He has also allowed Ludmila W. to listen to his silent violin. She wore the headphones for nearly half an hour today while he played. She says that he plays beautifully, and the tone that he produces from his massive sheet-aluminum violin is vastly superior to wooden varieties. I find all of this hard to believe. Although it is an unpleasant thought, I recall a memorandum issued last year warning specifically about the survivors of the psilocybin intensification experiments: they are "highly suggestible," the memorandum states, and "given to unusual, spontaneous, sympathetic flights of fancy of a highly irrational nature." Perhaps an unflattering thing to think of the marvelous Ludmila W., but a possibility we must keep firmly in mind.

The augmented wheat rust is doing very well, although I have yet to eliminate–or even isolate the origin of–its powerful carnivorous tendency. On the other hand, it occurred to me quite suddenly this morning that we should perhaps not be so hasty to stamp out this genetic miscalculation. Many of the greatest advances in science have come about through chance and error skillfully taken advantage of, and it seems to me that a spore-reproducing carnivore could have valuable tactical applications. Carnivorous wheat rust, I imagine, might well prove to be the ideal perimeter deterrent to guerrilla warfare. I plan to keep my opinion carefully hidden from Klysterman, who still insists on the destruction of the augmented ergot. He would be certain to try to steal any credit due me.

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September 26—

Tragedy in the lab today—but tragedy of the most educational nature. A technician, in feeding the augmented wheat rust this morning, discovered unwittingly that the ergot has, as predicted, now developed the capacity to generate effective lysergic acid derivatives. What we did not suspect was that it would concurrently develop the instinct to use this hallucinogenic ability in a tactical, strategic manner. In bending over the spore case—which we now estimate contains nearly fifty pounds of the mutated *puccinia graminis*—the technician was suddenly and without any apparent warning sprayed with a gaseous hallucinogen. Stunned and disoriented by the surprise attack he allowed his ungloved hand to brush the surface of the carnivorous ergot. The damaged portion of his arm was amputated and vaporized and at this hour the wheat rust is apparently still confined to its spore case. The technician is under heavy sedation and being treated by competent prostheticians.

There is no question in my mind that the carnivorous ergot has happened upon a remarkable new offensive device; enough, I would say, to put the spitting cobra and even the sophisticated toxin of the lionfish to shame. A new confidence fills me at this moment: the ideal biological weapon may be within our grasp.

Ludmila has perfected the wheat rust deployment device. The slightest sound fractures the case and allows the contents to escape, and the material of the unit is entirely biodegradable. I joked with her a bit: a sound-actuated trigger, I told Ludmila, not much defense against a silent violin. She seemed remarkably subdued considering the unqualified success of her project.

Ludmila W. continues to show what I must consider an unhealthy and even perverse interest in Klysterman. I have learned lately that she has visited him in his dormitory room several times this week, presumably to hear his silent violin. I mean to discuss this matter seriously, at length. It is necessary that she understand the nature of his fraudulent appearance. This silent violin prank has gone on long enough.

September 27—

Klysterman is no longer so vocal in his threats that he will have the project taken out of my hands. He is building a second silent violin which I fear he may try to present to Ludmila W. The massive foolishness that this waste of man hours and materials represents is astounding to me. Klysterman is a perpetual annoyance; in and out of the lab constantly with his silent violin and his plans for a new one. Ludmila W. talks to him with animation and enthusiasm. I cannot stand Klysterman. He would like to see me fail; his attitude and new frivolity are altogether beyond my understanding.

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September 28—

As of this morning, my speculations on the strategic value of carnivorous ergot have become a matter of laboratory record. To say that my modest efforts were received with intense interest, even enthusiasm, would be only to understate the truth. The spore-bearing carnivore has already generated more excitement, I think, than any project since selective botulism. This is very gratifying to me.

Klysterman, however, remains an annoying puzzle. He has for the most part ceased to be antagonistic about my augmented ergot; no more talk about destruction of the fungus or shipping it away from my authority—in fact he now displays an almost proprietary interest in the welfare of the wheat rust, coming in four or five times a day to lean over the spore case, his huge nose pressed against the plexiglass, smearing the plastic by wiggling his fingers and tapping on the cover.

A brief and somewhat laudatory announcement was made at lunch today regarding the tactical ergot project, so I suspect that by now Klysterman has realized the magnitude of what I have isolated, and he hopes to curry favor through his solicitousness. Little good it will do him, I might add, though it is, at any rate, a pleasant turn in his unappealing character.

September 29—

While the augmented ergot project is easily a significant professional victory, I cannot help but feel that somehow I have failed personally with Ludmila W. I had hoped that we might develop some sort of relationship that would extend past the laboratory and into more intimate realms. She is with Klysterman continually now, except for the short time she is compelled to spend with the wheat rust project. He has begun to instruct her in the silent violin and I think this occupies more of her attention and interest than all of what we are doing experimentally. The Tchaikovsky Concerto in D, Ludmila tells me, the first movement alone as Klysterman plays it would say more to me about life than a full chart of the Crosby-James amino acid progressions. Her new mysticism is both distracting and disconcerting to me. I am soundly disappointed at her adolescent foolishness.

September 30—

My initial requisition for experimental animals arrived today; fully twice as many as I had ordered—some indication, perhaps, of the new priority of tactical ergot. The basement of the lab is now crowded with a generous complement of the smaller rodents, an excellent assortment of domestic barnyard animals, a full kennel of dogs and a neat, compact selection of the more notable tropical and subtropical vertebrates and lower primates: a total of nearly four hundred subjects ready

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for our investigation of the carnivorous ergot strain, and Ludmila W., the beautiful, inscrutable Ludmila W., shows no more interest, or enthusiasm, at the prospect than do our thirty-five rhesus monkeys freshly out of quarantine. She and Klysterman are entirely beyond my understanding: there is such a gap between us that we might as well not try to talk at all.

Klysterman, I think, does not as yet realize the jeopardy that his light-hearted excesses here at Beta Lab have placed him in. There is serious talk, I am told, about relieving him of his technical responsibilities and reprocessing his work-status, due to the extreme and frivolous nature of his current experimental diversions. No more than two months ago Klysterman completed a magnificent, elegant central nervous system disrupter—massive, noiseless, long-distance CNS disruption operating on the most sophisticated of principles—and then he dropped it almost overnight to pursue the idiocy of his silent violin. Individuals who have examined the violin tell me that at least half of it is based directly on devices pirated by Klysterman from his discarded CNS disrupter. While a great deal of eccentricity is tolerated here at Beta Lab, in wise recognition of the part free inquiry plays in scientific progress, prolonged pointless nonsense, such as Klysterman's violin, simply will not do, and I am certain that Klysterman will soon feel a small amount of pressure on him to return to productive pursuits.

October 1—

Although it is a distasteful idea, I cannot help but wonder once again what influence the psilocybin intensification project had on my attractive colleague Ludmila W. I have noticed certain aspects of her behavior that are odd: odd, perhaps, past the delicate point of personal whimsy. Ludmila W., I suspect, harbors unusual notions—how to say this properly?—is a bearer of remarkable fancies that make it nearly impossible for us to communicate at any length. She has begun of late to bring small portions of food wrapped up in a napkin back from lunch to feed the ergot—"treats" she tells me, "treats for the fungus." I have explained to her the experimental necessity for a careful regimentation of the ergot's diet—no chicken salad, I admonish her, no meat balls, no gravy. Ludmila ignores me as if I do not exist. There are moments when I sense that, regardless of her prodigious technical abilities, she is not happy with the work done here at Beta Lab—and that, in fact, she bears me some malice for my own successful career here.

And I would in no way be surprised to learn that she is responsible for influencing Klysterman away from the promising professional future which he now seems intent upon destroying with foolishness.

Klysterman continues his ritual of visiting the ergot daily, waggling his fingers and moving his lips silently as

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he leans over the case, oblivious to the stares of my colleagues. I have begun to entertain disquieting feelings about smug Klysterman and the carnivorous ergot: is there something that Klysterman is aware of that has escaped me?

This evening, however, I am elated: today we ran the first series of tests with the lower primates—remarkable in every respect. The ergot is quick, efficient, silent, hardy—certainly all that one would want a fungus to be.

October 2—

This morning I noticed that Klysterman has logged a great deal of computer time in the last two days. It is not difficult to tell from the records that he has been running extended analyses of the ergot's future generational profiles. Yet he has said nothing of this to me and has even removed the duplicate readouts of his computations from Central Reference. This is most suspicious, and, in fact, upsetting to me. There is some significance here, I am certain.

October 3—

Today I stopped Klysterman when he first came in to moon vacantly over the ergot. I demanded that he tell me what work he had been doing with the generational profiles on the wheat rust and why I had not been informed. Klysterman is slippery—Klysterman is a sly individual, there is no doubt about that—and he simply smiled in his distracted fashion and said little. Nothing had come of it, he told me, far too much genetic distortion had taken place to allow accurate predictions and it was pointless to try anymore. Perhaps he was telling the truth: he is the expert and I am inclined to believe him, for the time, at least.

The hallucinogen generated by the carnivorous ergot is becoming increasingly sophisticated with each new sporing. While initially it appeared to effectively produce instantaneous disorientation, our most recent results with the primates strongly suggest that it now has some positive attractant factor. The youngest of the ergot simply waits placidly in one corner of the test cell and the subjects go to it. The lower primates, in truth, seem to be distinctly cheerful throughout the entire procedure, as nearly as we can tell: all of this is very strange and exciting to me, and only furthers my conviction that augmented wheat rust will presently give us some interesting and significant turns.

October 4—

I have come to wonder: just what is Klysterman doing? He and Ludmila W. have taken to almost constant association with each other and a reticence—should I say almost a fanatic secrecy?—that inspires the worst sort of suspicion in me. There is some pattern in all of this, I am certain, some small key that Klysterman is deliberately concealing from me. He continues to log computer time for his generational analyses,

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clumsily disguising his efforts by using misleading programs and inputs—but the nature of his activity is transparently clear to me.

I stop Klysterman in the halls now when I see him and demand as strongly as I am able that he inform me of what he is doing. He smiles—that wondering, beatific smile—and shrugs; "no more is possible" he tells me. Too much genetic distortion he insists, nothing else can be done. This is untrue: Klysterman has developed techniques, he and Ludmila W. together have created projection procedures that are unavailable to me. The two of them have become a significant distraction and a source of no little concern.

The augmented wheat rust continues a magnificent evolution—unquestionably we here at the lab are the first to witness living matter achieve such sophistication in so few generations. I predict a general leveling-off of the mutation process within three or four generations: it seems to me that there is little left to improve on in this magnificent fungus. Production has already begun to tool up for the deployment devices—slightly modified now, with somewhat more of the antipersonnel flavor about them—and the final series of trials will be run this week with South African vertebrates. Within the month I will be sent East for a program of briefings. I feel more than slight pride with each generation that develops, thick and yellow-brown on the spore case. Klysterman is, in perspective, only a minor annoyance against this achievement in strategic biology.

October 5—

I will not allow Ludmila W. and Klysterman to distract me. All I can conclude is that they are in the grip of some contagious insanity and that their odd behavior is symptomatic of mutual mental disturbance. I will have to take steps unless Klysterman excludes himself from the premises of the tactical ergot project and Ludmila W. returns to her normal duties. There is only so much which I can tolerate.

October 6—

Klysterman in and out many times today, his silent violin strapped to his shoulders, checking on the ergot. There seems to be no way to keep him out. More computer time registered under his name this afternoon. Ludmila W. leaves the lab early today claiming illness. All this very suspicious.

October 7—

What is Klysterman trying to do to me?

October 8—

Symbiosis: I could never have foreseen it—there is no way I might have guessed. Klysterman and Ludmila must have had techniques, derivations, extrapolations, syntheses: they must have had insight, pure burning insight, to see in the tracings

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of sugars and phosphates, in the bondings of adenines and cytosines and guanines and thymines—to perceive even most dimly the conditions that signal symbiosis. And I fear that they perceived far better than dimly.

This morning I unlock the door of the ergot project and find Klysterman already inside, Ludmila W. standing behind him, the plexiglass cover and sides of the ergot case smashed almost completely. "Best not touch me," Klysterman says and sweet Ludmila nods her head. When I come closer the change in their appearance is obvious; Klysterman is completely covered with a thick layer of the ergot—only his hair and eyes and fingernails are as they were. Ludmila W. is the same, a fine yellow brown velvety covering spreads over her features like stage makeup, adhering as tightly as skin. "A step forward," Klysterman tells me. "A logical extension of your fine work. Evolution in its purest state."

The spore case is empty: as neatly cleaned as if by ultrasonics. Klysterman babbles on about evolution, but I cease to listen to him. Ludmila's arm is a chalky brown, thicker now, and nonreflectant as dried mud. When she smiles her teeth are intensely white.

"The most marvelous of symbiotic relationships," Klysterman insists. "A genetic contract signed and sealed for eternity."

This afternoon Klysterman went out on the street to find someone to perform a marriage ceremony for him and Ludmila. No one was certain just how to stop him. For the moment it seems wiser to give Klysterman his way: the ergot is apparently neutralized only so far as its symbiote is concerned. God knows what reality is for Klysterman now, wrapped up in lysergic ergot like a lungfish in mud.

While Klysterman is gone, Ludmila W. perches on my desk, headphones over her thick brown ears, sawing away on her silent violin as if all were normal. To be polite I attempt to make conversation. We discuss her impending marriage. She would like children, she says, and I ask her how many. Maybe ten, she tells me, or twenty, or forty, or fifty. She laughs: maybe more.

Ludmila hasn't heard of overpopulation?, I wonder aloud.

She looks puzzled: What overpopulation? Two of us, she tells me, are not even enough for a string quartet. ■

DON'T LOOK NOW BUT . . . Neutrino astronomers can't seem to find as many neutrinos coming from the Sun as theory predicts there should be. Does this mean that the Sun is *younger* than astrophysicists think?

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Everybody "knows" the difference
between food and poison.
But some poisons are subtle.
And on an alien world . . .

by CARL A. LARSON

Strong Poison 2

None of us is likely to be among the migrants leaving the confines of our planetary system, though they will carry faithful copies of our genes, fulfill our dreams. They will be called Jane and Ivan, Alma and Tom, Tamara and Martin—unless our tribe is doomed to change in its early extraterrestrial settlements, losing the drive that once made us masters of this planet. If we count on only one "human" trait being preserved, that of exponential population growth, our descendants will be forced to leave this solar system in quest of living space. Sooner or later our species will meet entirely new poison hazards; as threats to individuals in the case of planned and well prepared reconnaissance; as a menace to an already changing, not quite human species, in the case of an exodus forced upon breeds which have sold their birthright for a mess of pottage.

The key word will, in both cases, be *selection.* Sooner or later, with or without intention and plan, transmundane populations will adjust to entirely novel surroundings. To a marvelous extent human beings can measure up to dour environments, but when a population, or a species, adapts to conditions of near-extinction through pest and poison it will invariably be through sacrifice of individual lives. In the long run it simply will not be a matter of survival of the sufficiently fit; a goal-directed species will have to redefine its fitness estimates with changing conditions.

Predictions about the forging and molding effects on a human, or human-derived, species by virtually exterminating poisons of worlds with alien suns would at first blush look like extravagant guesses. As a matter of course we have sparse data about the main hazards that will meet migrant populations beyond the realm of Sol, and none about organic poisons likely to threaten our descendants. But we know some principles,

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sometimes sketchy, of human population changes under grim environmental conditions. We possess a growing, if crude, knowledge about ways and means of living beings to handle poisons; and we may have, as a forthcoming species, been through similar hazards in jungle and rain forests.

In the crucible of starvation a population may suffer predictable losses among children and old people, its mass will contract, only to expand again, given time and good harvests. Selective forces at work through such catastrophes will be subtle as to their effects. Radically different results can be observed in epidemics killing the feeble, the elderly, but also a high proportion of people under thirty, including healthy young men and women. Those above thirty are survivors of an earlier epidemic. Immunity, or increased resistance, is the short answer to a riddle with a few subtleties of its own.

Poison hazards, however, as they meet tribes which are forced to change their staple diets, could add some not so subtle patterns of selection to the increased jeopardy of feeble and unprepared individuals. It is a curious fact that recent events have provided a model of what may have happened to our primate forebears and also of analogous dangers that could meet our great-grandchildren as fugitives on a guileful planet. When African and Asian students at European universities were observed not to drink milk comments were few, some European students don't drink much milk. But somebody asked why, and got such answers as: "But I do when I need a laxative," and "Milk invariably gives me collywobbles."

Proving milk to be a poison to some non-European students, or what? Just wait a little. Enzymologists read up on the matter and found it had been "known" since 1954 that benevolent givers of dried milk to people in Africa were carrying on what by no means could be called chemical warfare against defenseless ethnic groups, but certainly was a less harmful model of such undertakings. To make a long but fairly monotonous story short: Caucasians have, over many generations, become adapted to a high intake of cow's milk—as far as we can see now, through selection. Fair dairy maids and farmers' daughters may have been a little less keen on founding families with wooers whose guts would ruefully rumble when exposed to milk. You wouldn't call this effect poisonous? Or not a result of strong toxic action? Right as far as the individual is concerned, but this is how selection works. People of European origin mostly belong to the minority of the world population tolerant to lactose, milk sugar, after infancy and early childhood. During the first year of life, or, decreasingly, in the first few years, Asian and African children have active lactase, the enzyme converting milk sugar, quite like Caucasian children. Then most

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children lose their intestinal lactase activity. As long as they don't come upon the idea of ingesting milk they know nothing about their "deficiency." A practical knowledge of the effects of milk in adults is prevalent at least on Bali, where milk is taken as a laxative.

We could, of course, envision a strange new world supplying poisoned manna to space migrants, selectively killing everybody above age four. The intensity of poisonous action—we shall return later on to what we could reasonably expect on the lines of true poisons—could, of course, vary greatly in parallel situations, but let us try another model. A number of our forebears were constrained to feed on emergency comestibles which became their main victuals within a few generations. Those who had, or readily developed, the chemical equipment necessary to digest, absorb and utilize the new food had big families and became prevalent. Those who could not adapt in this way—through sacrifice expressed as small family size and childlessness of some members as well as through chemical adjustment in others—the makeshift food could be a genocidal poison by lowering the nutritional standard and fostering disease resistance. A genocidal poison need not be a dramatic killer of individuals.

Let us be very careful now before we agree on too much. A poison, unqualified, can kill or change an individual; a substance, *z*, can kill or change a human, or humanlike, population, so we may call *z* a poison—right? We certainly come up against an ambiguity at this point. Here time becomes a critical factor and not only with regard to terminology. We are more prone to call a swift deleterious action poisonous than a slow effect. When human populations are concerned we have to count both types of injuries: those reducing population number and survival chances over a few generations and, conversely, unobtrusive changes sapping the life force of a numerous population through a considerable length of time. In both cases our interest is centered on the survivors. How will they differ from the goners? By possessing a little more, or a little less, of an enzyme somewhere in the alimentary canal or active in the intermediary metabolism? Perhaps the emerging tribe will look and act quite out of line with ancestral generations?

A close-up of the spaceport at the time of the great skedaddle will show you men and women in mute despair, hollow-cheeked, tired, but not unlike the crowds at the railroad stations of European cities when THEY were closing in on their prey. A few Martian generations have not changed humanity very much: Dick and Clem, Claire and Margot have lost nothing of their ability to make a mess of things. Now time is out, the spaceship is leaving and the thin hope of survival under a remote sun is aboard.

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Other crews have left ports drawn on to more well-defined goals, better armed materially and in a spirit of conquest, but great migrations have, since the dawn of history, been more or less manifestly compelled by the shove of trouble at home. A daring spirit has certainly been a better companion on a long and perilous voyage than bleak despondency. There is no need to tone down the importance of crew selection for the final outcome. But badly prepared migrations to well-nigh unknown planets will parallel the flight of hominid flocks from one deadly danger into an entirely new set of hazards: among funkers and gallants there are few to survive.

On account of the smallness of such founder groups the populations emerging from them can differ from each other and also from the original population with regard to gene frequencies. This is a mechanism different from selection: genes without apparent advantage with respect to survival of the individual or the species can establish themselves. In extreme cases the partner gene can get lost; American Indians virtually lack the blood group gene B. If fifty percent of our Martian descendants have gene "heads" and the other fifty percent its partner gene, "tails," we can readily get a model of what could happen if just four persons became parents of the new population on the planet Guirid by flipping four coins. There is a chance of one in sixteen "tails" getting lost and the emerging population will be all "heads." There is safety in numbers, if there are two hundred founder parents faithfully representing the gene frequencies of the initial, Martian population, the chance of losing "tails"—or "heads"—completely is only $(\frac{1}{2})^{200}$.

What has happened in the prehominid past, and what will happen again, is that relatively rare genes will be exposed to repeated risks of getting lost; that similarly other genes, rare or moderately common, will reduce or increase their relative frequencies in migrant populations, through no apparent adaptive value at all. But the strange new environment will start playing with such populations, stunting them with extreme gravity fields, harassing them with unaccustomed magnetic forces, radiation, extreme temperatures, poison. Under some of these conditions "heads" might reveal a completely unexpected advantage, another planet could offer "tails" a warmer welcome. Changes of this fortuitous kind are rapid; even without selection a single generation of reduction to a few individuals, plus a few generations of increase in number, suffice to let a "new" population emerge.

But the profound, adaptive changes in a new surrounding are of another type. If we put together what evidence we have about poison hazards outside our planetary system, it is largely indirect, and some evi-

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dence of a fundamental nature is a little shaky. Before going into this problem complex we must shoot a cursory glance at the efficient type of Homo transmundanus adjustment as different from what can happen when "neutral," nonspecific genes become established by mere chance—through various kinds of what has been called "genetic drift." Remember, selection *may* give "tails" an edge over "heads," but this is by no means necessary for the chance supremacy of one gene over its partner gene. The invariably efficacious way to thrive in a new surrounding is to sacrifice the nonadaptive gene and keep its adaptive, in the specific surrounding superior, partner gene. This is selection, in one way or the other it means that the species sacrifices some members to survive as a species.

In principle, this sacrifice could occur simply by poisoning everybody who does not carry the advantageous gene. Would the less successful partner gene disappear then? It could well happen, swiftly and completely, but again the number of individuals is the joker in the survival game. Let a fairly large crew arrive safely on planet Haljo only to be poisoned right away with an unforeseen bane. The survival gene S could be relatively rare, and the crew correspondingly reduced, or it could be the standard gene, with a few fatalities, limited to those carrying only the nonsurvival partner gene, s. In both instances crew members would most likely be SS, Ss and ss, with only ss—majority or minority—going to the wall. This is because each ordinary gene and its partner—allele—have two sites: in the paternally and maternally inherited chromosome of each pair. And so Ss, the heterozygotes, will survive and new ss will crop out to be killed in the next generation. From an initially high frequency complete elimination of all ss will, in a few generations, reduce the s frequency to a low percentage; if s is low at the first poison exposure a small and very slowly decreasing number of casualties, of ss individuals, is likely to occur in every subsequent generation until a bottom level of s frequency is reached. The preservation of this detrimental gene may, as we shall see, mean survival in the next galactic abode.

At this point we may well ask about evidence. Outside our planetary system thought may be bent on escaping rather than worrying hard, and sometimes very unpalatable, realities. Can we really know anything about the effect on migrating human populations of trans-solar poisons? We shall take a look first at the poisons, then at the distribution of human genes enabling our descendants to cope with them.

In a troubled world there are men and women who can tell you: "We kissed the soil when we had passed the border." Something like that would be less likely to happen on an unknown planet, under a pale for-

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eign sun. After a long voyage, would anybody be careless enough to breathe the poisonous atmosphere of the haven attained? Though various kinds of inorganic poison can be taken for granted, wherever we go within the galaxy, we will be protected against them. It is something else again that protective devices can be fatiguing to the extreme and leave space travelers little resistance and vigilance to bear up against more insidious poisons.

To this latter class we would refer stuff interfering with specific chemical processes involved in the maintenance of life. Keeping close to what we really know, we would guess at organic poisons laming enzymes known today to occur in variant molecular forms in some persons. Mineral poisons inactivate an enzyme in all mammals. Arsenic inhibits sulfhydryl enzyme systems essential to living cells, to mention one case in point. But it is easier to think of organic poisons as fitting nicely into the locks of human life processes, impairing only one molecular form of a specific enzyme. There is fairly good reason to think of carbon compounds as present throughout the universe.

True enough, messages from space reaching our planet as meteorites may not permit far-reaching conclusions about the composition of interstellar matter. On the other hand our sun is a rather common G star, meaning that about fifteen percent of the stars in our galaxy belong to the same spectral category, with a temperature of some 6,000° C. Astrometric investigations have demonstrated perturbations of stars that fit the idea of unseen planets—with our present equipment Earth would be unseen from one of them. It would not be too rash an assumption to think that meteorites may tell us a rather common story about galactic conditions.

One of these messengers appeared, with light and thunder, at Orgueil in southern France on May 14, 1864. Some twenty fragments, fist- to head-sized, were collected and studied. They were carbonaceous chondrites, a term applied to carbon-containing meteoric stones with chondrules, or rounded granules of mineral embedded in their mass. We get many such dispatches from the asteroid belt circling between Mars and Jupiter, so we know there is carbon, but not all of them are read as carefully as the Orgueil stones.

The gist of many refined laboratory studies of these stones is that their hydrocarbons resemble those produced by living organisms, but the porosity of carbonaceous chondrites has made people question the cosmic origin of such hydrocarbons. Terrestrial contamination is a tricky thing to exclude.

Recently NASA exobiologists got hold of uncontaminated material, from a stone dropping down near Murchison, Australia, on September 28, 1969. When they examined large fragments with gas chromatography

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and mass spectrometry the NASA scientists found five amino acids known from living organisms, including human beings. They found other amino acids, too, and dextrorotatory isomers of the terrestrial type amino acids: glycine, alanine, valine, proline and glutamic acid.

This is a point where one should stop, look and listen. Amino acids occur in two different forms or optical isomers, their asymmetrical crystalline structures twisting the plane of polarization of light to the right, D form; or to the left, L or levorotatory form. Amino acids entering as building blocks into our enzymes and structural proteins are L isomers, and so are the amino acids of organisms eating us and being eaten by us. Why shouldn't proteins on so far unseen planets—and G type stars *might* have one or two planets, on the average, where life has taken hold—be composed mainly of D amino acids? If so, meat on a dextro planet won't exactly poison the terrestrial consumer, but such proteins would be rather inadequate for growth and tissue repair. And food could be very palatable indeed without containing arginine and histidine, but both these amino acids are, together with eight others, indispensable for normal growth. If our great-grandchildren try a diet where one or a few essential amino acids are substituted, and there *are* alternatives to think of, this diet could act as a true genocidal poison. It could be useful to think of the Murchison message as a reminder of such possibilities.

There is, however, another type of conclusion to be drawn from observational facts as secured and interpreted by the NASA exobiologists. An electric discharge, when repeated in a mixture of hydrogen, methane, ammonia and water, will produce various kinds of amino acids, D and L, in proportions resembling those of the Murchison stone. When the cosmic amino acids are considered abiotic, originating in the absence of life, they are by no means off our present subject.

In the first place, the mixture producing amino acids under laboratory conditions is present in the cloudy masses of Jupiter's cold exosphere; someday you may be able to go to Io and have a close look. Then you will see what our planet once looked like, under life-generating conditions that were certainly more conducive to the origin of life as we know it. But there is nothing telling us that life in other forms is not being generated in the lower and temperate cloud layers of Jupiter. Our next concern will be with life factories in interstellar space.

There strong poison, by any definition, is indeed met with though it is of no great interest as such. Interstellar gas clouds seem to contain hydrocyanic acid, methyl alcohol, formaldehyde, formic acid and cyanoacetylene. Nobody will go there unprotected; of interest, in our present context, is that such gas

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clouds represent virtual pilot plants for prebiotic organic compounds, including amino acids.

Again we meet conditions resembling those of our own planet when early self-replicative molecules arise. This is about what scanty knowledge we have today. But by reasonable inference we may assume that it is at least possible that some of the billions of extrasolar planets have passed stages of prebiotic chemical evolution similar to those on Earth and that a launching of various life forms has followed. Our descendants may well meet the bewildering abundance of foodstuffs and poisons that our forebears encountered when ousted from their arboreal Eden.

Given an infinite number of life-sustaining orbs any number of poisons could occur, from the deadly gas oxygen, nipping life in its bud, to elaborate poisoners successfully surviving the attempts of highly intelligent beings to eradicate them. Among space migrants rapid selection may occur against those who won't accept the challenge of the entirely unknown.

As for life processes exposed to cosmic poisons, and the selective events mediated through more or less severe disturbances of such processes, we may depart from our knowledge of metabolic cycles in man and mammals. Briefly, chemical processes occurring in some cosmic formations and industrial plants at high pressure and elevated temperature can take place at body temperature in the presence of catalysts. In the course of evolution plants and animals have come to be increasingly dependent upon biocatalysts, enzymes, which further various links in long chains of chemical events. At any level two links can be separated by inactivating the enzyme that keeps them together. Inactivation can be brought about by, for instance, a plant poison, or through failure of the gene controlling the production of the enzyme. Scores of such genes are known just because defective variants of them have been observed, mostly in persons carrying both substandard genes.

So far we have seen a lot of detrimental effects of such enzyme inactivating genes and barely enough advantage to build models of what could take place. Generally speaking, a human population would be better off in an entirely new surrounding, with unknown poisons, if it carries a number of variant genes. Going back to the pattern already mentioned, it would be fine for an individual to have both normal genes, that is being an SS homozygote, as long as he stays here, or on Mars. A population of only SS individuals leaving for the great unknown could succeed—or they could be all killed. Crews composed of SS, Ss and ss individuals have a better chance, one of the three keys *could* fit the new ecologic lock.

What we have seen in somewhat parallel situations here is Ss individ-

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uals being favored, in taxing surroundings, at the cost of both SS and ss individuals. It is very likely that foreign planets will offer situations where ss persons rarely reproduce, SS individuals often though not always, are poisoned to death before having a family and Ss heterozygotes prevail. To complete such simple patterns we may think of the scores of different genes known to occur in a rare, substandard variant responsible for an inactive enzyme, while the normal variant produces full activity of this specific enzyme in homozygotes—AA, BB, CC et cetera—and about fifty percent enzyme activity in heterozygotes. Then we should add a few hundred similar genes so far not observed.

But selective processes of a more subtle kind have been, and are, at work here right now. Basically, it is the same pattern with the modification that no homozygotes are rare and neither EE or ee, say, are obviously handicapped. In some instances differences in enzyme activity are concerned, but these differences need not be at all critical. As a matter of fact the apparent health of the four percent of the Toronto population revealing a seventy-five percent activity of serum cholinesterase fits the pattern of several other enzyme variants; we can get along quite well with far less than the highest enzyme activity as observed in, for instance, EE homozygotes.

In such instances selective forces of a mostly obscured nature are at work, otherwise seventy-five-percenters in the case just mentioned would be much rarer. Though the enzyme variants were detected through abnormal reactions to muscle relaxant drugs, it is not a question of selection in fervently drug-consuming populations. Selection may well act upon qualitative differences, crudely observed in the laboratory by means of electrophoretic technique, which we know to be inherited in a reasonably simple way. But what kind of selective forces could conceivably be at work in modern Western populations?

Perhaps this question puts the saddle on the wrong horse. Should we ask, instead, for selective forces operative until quite recently?

Though questions of this kind may be of crucial importance to rapidly growing human populations here and now they are sadly hard to answer. We know about teeth and skulls of our hominid ancestors, and such evidence may have conveyed the impression of evolution as a slow process, but we know nothing about the distribution of enzyme variants a hundred years ago. When fairly common gene variants are involved, we have to count both with the possibility of selection at work—for and against a variant gene with a definite advantage in some respects only—and with the relaxed selection against other genes which are now increasing their relative frequency.

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They still will need a few generations, in the latter instance, to outrival their relatively rare partner gene or genes.

As far as heritable variants of serum cholinesterase are concerned we may have some clues. Under rather specific circumstances the gene determining a less active enzyme variant may convey a distinct advantage. Some African tribes have used the calabar bean for trial by ordeal. The suspect had to swallow a few rather innocent looking, big beans. If he was innocent, he vomited; if guilty, he died from respiratory paralysis. There was a third possibility: he could be guilty and still survive--because he carried a gene for an atypical cholinesterase not lamed by the bean poison.

Miscarriage of justice on account of an atypical gene in the defendant may have interesting sociologic aspects, but we have to leave them and ponder the question of enzyme inhibitors distributed in food plants. They are not as violently poisonous as that occurring in calabar beans, but many common vegetables have been observed to contain enzyme inhibitors which can, under untoward circumstances, cause disease and even death. We have little precise knowledge about the selective effects of such agents and we might be inclined to think that the inability of Homo sapiens to avoid poisonous vegetables would belong to prehistory. If so, we would be mistaken.

In the 1830's crops failed in some districts in India, the seed of Lathyrus sativus was consumed as a substitute food and "the younger part of the population. . .from the age of thirty downwards, began to be deprived of the use of their limbs below the waist. . ." The same thing happened to about sixty thousand persons in one Indian district in 1922; similar outbreaks of paralysis were observed in 1945 in India; even Spain, France, Italy and Syria have had epidemics of "lathyrism." We may keep the possibility open that plant poisons, strong, weak and conditional, have until recently balanced some human enzyme genes at a level comparable to that of blood group genes.

Upon such systems of relatively frequent gene variants with distinct selective advantages and disadvantages biogenic poisons may act on new planets. The result could well be rapid selection for genes determining specific enzyme variants. This type of adaptation will occur at the cost of individual reproduction or even individual lives, but part of this cost has been paid in the long past when originally "substandard" genes became established at high-frequency levels.

What if entirely new genes, engaged in enzyme production, arise because of the rather intense cosmic radiation on Mars? We have to count with mutations which are not new and untried, but rather occurring at a somewhat higher rate than here. One

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side of this increased rate of mutations which have been weighed in the balance and found wanting is a somewhat increased rate of death and infertility until the mutant genes have reached their new level of equilibrium. Would that be the worst thing that could happen?

Probably not. This is a tricky point, I for one am not sure we *could,* in any reasonably Martian-like environment, by practical, workable devices, substantially reduce our "natural" mutation rate. If we, or our grandchildren, could bring about such protection, it might be a little worse than a high mutation rate, but not the worst bane that could poison our future space.

A fairly high mutation rate increases the survival potential of a species striving to conquer new worlds. But it is by far not the sole factor of survival. For a species to keep alive, it must keep genes that make individuals die. But even with a moderate rate of mutation we can keep such genes concealed through scores of generations. They are balanced and made temporarily innocent, not only by "good" partner genes—the situation Aa—but also by some of the billions . . . repeat: billions . . . of other gene combinations in which they are, have been, and will be tried in human beings. Even if we overprotect ourselves against mutations we will have a chance, perhaps somewhat reduced, in new planetary homes.

New and unsuspected poisons may cause mutations in the somatic cells, as distinct from sex cells, of transsolar migrants. The toxin of Aspergillus flavus, a mold, which killed the economy of tropical countries exporting peanuts, has a potent cancer producing effect on mammalian, including human, cells, especially those of the liver. There are regions in Central Africa and South East Asia with a prevalence of liver cancer about one hundred times that of regions protected against the mold poison, aflatoxin. Such fungal parallels of bacterial, botulin type toxins, may constitute worse dangers than radiation in entirely new surroundings. They may produce mutations not limited to somatic cells. Still, there may be poisons in another sense, genocidal toxins stymieing human conquest of the galaxy.

In every situation our species has so far encountered we have had gene reserves empowering us to survive in desert and tundra. Could there be some complex gene manifestation, stimulated and selected for by hardship, which has in the long past endowed humankind with a general adaptability? Intelligence seems to be an emotionally loaded word, and sometimes a rather ambiguous term, but, if there is something remotely like a capacity to acquire and apply knowledge with a biologic foundation, it could be suspected of having had, long ago, a positive selection value. In entirely new and unexpected situations, where the appro-

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priate tools and weapons could not be brought, with habitual behavior patterns spelling certain extinction, it was the cunning improviser who prevailed. If Sek and Ghel concluded there was no need for them to try the berries that killed Ud, they stood a better chance of survival than those who had to taste the nice fruits for themselves. And it was Sek and Ghel who became patriarchs.

Perhaps we should not draw too far-reaching conclusions from this. High intelligence invariably may not, in every social setting, confer a higher survival value—a substantially increased chance of handing down certain gene complexes. Tapeworms are not highly intelligent, though they are perfectly adjusted and highly reproductive. Yet our Martian greatgrandchildren are likely to pick their crews for space pioneering among men and women possessing a high general intelligence. Such crews have, when odds are uncertain, a better chance of survival in unhandled situations. Selection for stupidity might become truly genocidal.

Though we know of a number of poisons which reduce available intelligence, some morbid imagination would be needed to construct a situation where a complex faculty like general intelligence would be selected against. The agent would not be a poison in its general sense.

It is another thing again that a number of genes for profound intelligence defect offer metabolic alternatives which may prove useful in highly specific, toxic surroundings. Every growing, new population would buy its survival by doing without complete protection against the poison hazard and keeping its intelligence.

Human populations can do such things; blind selective forces are not the sole agents forming our fate beyond the solar system. To speak of our kind as a goal-directed species could be grossly illogical—we really don't know where we are going. But we are the animals who know that we, as persons, shall certainly die. Many of us have an insight into reproduction and its relationship with its preambles. Homo sapiens is the animal who can tell himself: "There's food I'll eat, but not right now. I have other things to do, first."

And as soon as humans have felt very strongly this or that "other thing," they have acted quite differently from their mammalian cousins. Perhaps the goal was not worthwhile, as we can see it from a remote and dignified standpoint. The sword that gleamed in the sun, pointing to Damascus; the rallying around the flag—they made men and multitudes aware of powers never released by the better-spent effort of filling the greatest number of bellies, to the greatest distension, in the shortest time.

Could be that our kind needs a far-off goal to unfold its truly human capabilities. A venom would be fatal to our profoundest drives if it dimmed that distant goal. ■

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the darkness to come

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In a situation
where facts are scarce,
faith counts
as much as logic.
But when the faithful
reach the wrong
conclusion,
they still cling to it
stubbornly!
ROBERT B. MARCUS, Jr.

Now there was no doubt in Jans Deriae's mind. He had checked the calculations over a hundred times and always the figures led him to the same conclusion.

He wheezed slightly, clambered to his feet and hobbled across the starkly furnished room, coming to a stop before the gleaming metal sink. What would Dorins think if she could see him now? He was just a gnarled old Rangin who had outlived his health, dependent upon pills to prod his heart to beat and his lungs to inhale.

Deriae smiled and thought of his wife. She always said that he was the most obstinate person in the world. Too obstinate to die, Jans thought, as he shook a tiny blue pellet from an unlabeled bottle, put it in his mouth and chased it down with a glass of sijine. The pills were illegal, of course. The Council had decreed that it was unnatural for any Rangin to be kept alive by artificial means. When death beckoned one must always answer the summons. Deriae spat in fury, then relaxed. *They*—the members of the Council—did not know. They did not know he had friends, a chemist and a biologist, who had joined together to create his pills of life. It gave him a great deal of satisfaction to know that he had succeeded in deceiving the Council for fifteen myuths. Many times the Council had ignored a proposal of his; now he was ignoring one of its laws. But that was not the main reason he had to continue to take these pills. To stop would be to condemn the entire planet to death. His death would be the death sentence for Rangi.

He sighed heavily. His work was almost finished. He had only to convince the Council . . . then his death would no longer matter.

Deriae gazed through the polished glass of his window at the heavens far above. The clouds, a mottled bronze, clung to the bowl of the sky as if painted there.

It would not be easy, he thought. Few on the Council had ever seen the stars, and perhaps none had seen that particular star that gave warmth and light to the planet Rangi. Deriae had glimpsed it only twice in the two hundred thirty-three myuths of his life. But the last sighting had been only two myuths ago and it had been enough to convince him that the sun was smaller now than it had been the

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first time he had seen it. His measurements confirmed this. Taken together with the data of the Masters, Desgrave and Evere, only one conclusion was possible.

Deriae shivered, knowing however that his chill was completely psychological. His quarters were still warm, even though the temperature of Rangi had dropped ten units since Desgrave's time and fifteen since Evere's.

He shook his head and lowered his gaze to the surface outside his window. Narrow gravel paths wound through clumps of wiry purplish-green vegetation which resembled the feathers on Deriae's body. In the distance the muddy waters of the Tagrew River rippled with the turbulence of a storm, and even farther away a row of hills wallowed on the horizon, intermittently visible as the mists thickened and waned.

A good day for a walk, Deriae reflected, as a young couple, arms entwined, strolled into view on one of the paths. It seemed like only a day ago that he and Dorins had walked the same path. But Dorins was dead and had been for thirty myuths. Much had happened in those thirty myuths. He no longer ruled the scientific world. His theories were no longer popular. Jans knew why. One person was responsible for his fall. Aviam Winsz.

Deriae watched the couple and envied the boy's full wings, but what was the use of having them if one was too weak and too old to fly? Like most male Rangins over a hundred myuths his wings were clipped. It was odd. Why didn't Rangin females have wings capable of flight? Theirs were small and weak from birth. The case of the dyyplres provided a parallel example. The dyyplres were rare, living only in one tiny region of the planet, but they were much like the Rangins, though not intelligent and possessing no hands which could be used to grip things easily. But they, too, exhibited the phenomena of a flying male and a non-flying female. In their case it was because the male did all the hunting and was the only one that needed to fly; the female was generally pregnant, in part the result of an extremely long gestation period, similar to that of Rangin females.

Was there a connection between the two species? The difference was that his people lived primarily beneath the ground and had domesticated animals to eat; there was no need to hunt, and, therefore, no need to fly. It was an interesting comparison, though, and one worth considerable study. He wondered if he would ever have the necessary time. There was so much to discover; so little time.

He turned away from the window, a wave of depression washing through him. It was always the same. Looking out his narrow window started him thinking, and thinking usually led to depression. And yet he would not trade his surface apartment for one mired deep below the

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ground. Once all Rangins had been surface dwellers, but now few could afford to have an individual apartment built above ground. His wealth had advantages. How much the others were missing! The beauty and raw force of nature often elicited strange emotions that he savored for myuths afterwards. No, they could keep their artificial caves; he was content where he was.

He smiled again, sadly this time. Their subterranean apartments would probably keep them warm for many myuths after the sun had shrunk to the size of all the other stars, but it would do them little good. All food was raised on the surface. And it would die. And so would they.

The moment Jans Deriae brought his two companions to the zastrif garden he realized his mistake. It was too serene here. The tiny golden flowers danced by the millions in the wind. It was almost impossible for even Deriae to believe that his world was in danger. How could he convince the Councilmen?

As Jans listened to his friend, Liez Sjane, he tried to steer the other two Rangins out of the zastrif garden and towards the pits at the bottom of the hill.

"I've always supported you before, Jans," Sjane was saying.

Deriae nodded.

"I've helped procure the money you needed for your research. And when you wanted the Council to revoke the law forbidding any kind of life-sustaining drugs, I was your voice." He paused and rubbed two hands together. "But this . . . this I can't do. You're growing old, Jans. And your mind is aging, too." Sjane carefully avoided Deriae's gaze as he spoke and his red crest rippled as all Rangins' did when they were uneasy.

The third person made no comment but Jans could see that, though he was trying to be objective, he sided with Sjane. He was a head taller than Deriae and almost as tall as Liez. Deriae had not wanted to invite him but as President of the Council, Qoiuy Asderw would be useful as a Witness in case Sjane proved difficult to handle.

"Are you trying to suggest that I am approaching senility?" Jans asked mildly. He had to put his friend on the defensive.

"No, but I think you must have reached the wrong conclusion," Sjane said.

"From the data that I have gathered," Deriae said icily, "there is only one conclusion."

"I don't see that at all."

Deriae struggled to contain his anger. "I have devoted most of my life to the study of this problem."

Sjane looked at him with surprise.

"Yes, almost my entire life! I have memorized every observation and measurement that Evere recorded, and read every one of Desgrave's theories and writings about the stars and our universe."

"And you believe *Desgrave*? He

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spent the last thirty myuths of his life in an asylum," Sjane remarked.

"Desgrave was a genius and Rangins do not treat a genius kindly. We do not readily accept the truth." Even the Council recognized his work, Deriae added to himself. Desgrave *was* proclaimed a Master, an honor which was given to one scientist every hundred myuths. Jans knew that he would never join Evere and Desgrave in receiving that honor, however. They had lived in different times and Rangi had been ruled by Councils which were not as anti-science as the present one. Besides, Aviam Winsz had too much influence in the Council. He alone would be an obstacle too great to overcome.

"You're different, I suppose?" President Asderw said in a dry tone. "You always recognize the truth instantly, don't you?"

"When it reaches out and plucks my feathers, I do."

Sjane hesitated, flexed his wings. They were unclipped, Jans noticed, though Liez was beyond the age of flight. Sjane was slow to admit his age.

By now their path had brought them to the foot of the hill, where the pits lay. Deriae sat down on a nearby stone bench and the others followed his example.

"O.K.," Sjane continued, "let's assume you are right. What can we do about it?"

"I am not sure. All I know is what I have told you. Our planet presently receives most of its heat from a nearby star which Desgrave simply called the sun. Now my calculations show that Rangi has not always orbited this star. In fact, Rangi's present orbit is not a closed one at all, but rather a hyperbola." He paused, to magnify the effect of his words. "Our planet does not belong to this sun! Once Rangi circled a sun which is now inconceivably distant. Sometime in our past Rangi traversed that great chasm of emptiness. I do not understand how it was done. Our civilization has not yet developed the technology needed to transport an entire planet across that immense distance. But someone possessed the knowledge; some other civilization. It could only have been the people we call the gods."

"What?" Sjane exclaimed.

"I, therefore, believe that the key must be in the Chamber of the Gods."

"Are you suggesting that we open the Chamber of the Gods?!"

"Yes."

"But the gods—"

"They were not gods; merely members of an advanced race from some other world. They did not mean for us to revere, or worship, them; they came only as friends to help us."

"Stars? Other worlds? I'm sorry, but I can't believe any of it."

"But Desgrave—"

"I know what Desgrave hypothesized—I've read his theories. He envisioned a universe cluttered with

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thousands, perhaps millions of stars, many of which might be surrounded by planets such as Rangi."

Deriae was surprised by his friend's knowledge and he must have let his feelings show, for Sjane added:

"I've even read some of your theories, Jans, though I don't understand the mathematics in many of them."

"Then you must see that I am right."

"I see nothing of the kind. Face the facts, Jans, Rangi is our universe, our entire universe. Your theories and Desgrave's theories are beautiful intellectual exercises and are very interesting, but they still are wrong." Sjane was too dogmatic; Deriae knew he still had a chance. Whenever Liez was unsure of himself, he became dogmatic.

"But there have been hundreds of authenticated sightings of stars," Jans retorted.

"I don't deny that—there is little doubt that they exist. However, I am sure that they are nothing more than atmospheric phenomena. You have said many times that we know so little about our upper atmosphere."

"True, but what is beyond our atmosphere?" Deriae snapped. "What is beyond those clouds?"

"Who cares? I don't see that it really matters."

"I care. And you should," Deriae said.

"You're just being stubborn, Jans."

"Call it what you like. The future of our race depends on my stubbornness."

Sjane shook his head and flashed a hard smile. "I've had enough of this. It's difficult for me to believe that a man of your intelligence can be so obstinate." He stood up.

"Then you will not voluntarily bring my proposal before the Council?" Deriae asked.

"I would be a fool to do so."

"All I ask is to be allowed to examine the Chamber of the Gods."

"That is impossible," Asderw interjected. "It is forbidden. No one has ever entered it."

"The lives of our children are at stake." *Your* children, Deriae thought. He had often regretted not having any children. Now he no longer did.

"Are you finished?" Sjane asked coldly.

Deriae scowled and walked over to the glass wall that separated the three Rangins from the pits. He stared down at the thousands of mhinreqs teeming in the artificial chasms below. According to legend the gods had build these pits, just as they had built the five underground cities which all Rangins lived in.

Jans studied the mhinreqs. They were members of the only group of animals which could not fly, chiefly because they were too big. However, many of the bones necessary for wings were present just below the shoulders, even though the mhinreqs had no use for them. They were

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strictly ground animals and the main source of meat for the Rangins.

As he stood there an idea approached him. It had to do with the dyyplres—and the mhinreqs. It was such a farfetched idea, though. But the facts were there. The mhinreqs had primitive wing bones. Was it possible that the dyyplres were ancestors of the mhinreqs? Or more plausible yet, perhaps they descended from an ancestor common to both, yet different from both. And perhaps the Rangins descended from the same animal, gradually changing over the many thousands of myuths. Was it possible that the Rangins, like the mhinreqs, would one day lose the ability to fly altogether? It was a strange idea, but utterly fascinating. It also contradicted the current theory that Rangin had been created fifteen hundred myuths ago, since the earliest known records, which dated back one thousand four hundred fifty myuths, described mhinreqs and dyyplres as being identical to their present forms. And neither had the Rangins changed.

"Look at them!" Deriae exclaimed suddenly, waving a hand at the mhinreqs. "If the temperature drops another fifteen units, they will die. Twenty units and most of the plants will die. Thirty and only the very hardiest plants, which are completely unedible, will survive. On the original jump across space, the animals must have been kept below ground level. There are immense grassy areas in each of the five underground cities. These areas are now parks, but once could have been grazing fields for the mhinreqs and cropland for vegetables. But the planet was internally heated then. Now it was not—at least not enough. There could be no second jump."

"That's only your conjecture," Sjane said.

"It is a scientific fact," Deriae replied.

"But we are not scientists," Asderw said. "You do not expect us to understand such matters. Isn't that what you meant to say?"

Deriae did not answer immediately. "I am a member of the Natural Academy and as such I have the right to demand a Council hearing once every five myuths," he said.

"Did you bring me here to demand that I place your proposal on the agenda of the Council?" Sjane asked with a spark of bitterness in his eyes.

"Yes. As a member, you can do it much faster than I can. You can thank one of your inane laws for compelling me to ask this of you," Deriae remarked. He paused. "The President is my Witness."

Asderw made no comment but nodded slowly.

"It will destroy my career," Sjane said.

"I am not asking you to help defend my position," Deriae responded.

"That doesn't matter. You don't understand—"

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"I am truly sorry, Liez. You are well respected in the Council and you are on the agenda committee. It is within your power to schedule a hearing for me far sooner than anyone else could. I must have that hearing. I thought you would help me willingly. It seems that I must force you. I would rather not do it but—"

The spark in Sjane's eyes flared into fire. "As you wish—I have no choice." He glanced over at Asderw, and Deriae knew he had been wise to bring the President along. If he had not, Sjane might never have admitted that he had been approached about the proposal. His career was worth too much to him.

"I will bring your proposal before the agenda committee tomorrow. You will have your hearing within five days." He turned and left, leaving ripples of anger behind him, ripples that bounced off the pit walls and spread until a thin veil of anger covered everything in the vicinity, including Jans Deriae. So close, Jans thought. Success had not been far away. Liez had almost agreed to his desire willingly. It was not that Liez believed his dire predictions, but because of the friendship between them, a friendship which stretched back eighty myuths to the time when, on a hunch, Jans had lent Sjane the money necessary to finance his bid for a Council seat.

The President looked at him. "An hour ago you had a friend; now you have an enemy. I can't blame Liez for his actions. Was it worth it?"

"He is no enemy; he is merely angry," Jans said, but his thoughts were along the same lines.

He watched President Asderw walk towards the Pit Sector III lift. Was it actually worth the sacrifice to save an ungrateful world? He had little time left in this life; he would not survive to harvest any benefits.

He could not blame Liez completely. After all, he had placed Liez in the position of having to make an extremely difficult choice, but then, he had done that to Sjane before, and Liez had always sided with him. But time changed everyone. Liez had become at last like most of the other Councilmen; too concerned with his own future, his own career, to view new ideas objectively. The demon of ambition had seized control of Sjane's mind.

Deriae smiled once again, a little sadly. He was hardly one to be thinking like this. He was one person to whom nothing mattered but his cold equations. He had devoted his life to writing numbers in a book and now he might not even live to see if his most momentous calculation was correct. He was certain that it was—he could find no mistakes or even hints of mistakes—but even so, there were times when he wondered what relation a few numbers could have with the reality of the universe.

He gazed up at the sky and thought for an instant that it was

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black and emblazoned with stars. But it was only an old man's weary imagination deceiving him.

He turned and started the long trek uphill to his quarters, knowing that Rangi continued to sweep outward into the deep interstellar night.

The Council Hall was only half filled when Deriae made his way down the aisle to the speaker's podium. Irritation gnawed at his stomach. Today, would determine the fate of the entire planet and its myriad of life forms, and yet only a hundred Councilmen had bothered to come to the hearing.

Deriae took the platform and looked at the audience. The small attendance would work against him. All of his enemies appeared to be present. They would vote to defeat any proposal that he made. That would be fifteen votes on the negative side. He would have to convince almost five-eights of the remaining eighty-five if his proposal were to pass. It would be difficult.

"There have been times," he began, "when all Rangins had to cast aside their prejudices and unite in a common cause. The hundred myuths of heat forced us to do this. Only by pooling all our resources were we able to insure the survival of our race.

"And now we must do the same thing—for we are about to undergo an infinite period of extreme cold unless we take action. Once more the efforts of all may be needed to enable us to survive. Let us remember that there was much opposition to the Dedre Plan before the myuths of heat, but what was important was that it was finally accepted. We owe our lives to the foresight of our ancestors. And now we have the chance to insure the safety of our children. The choice is yours.

"I have been observing the weather on our world and studying the records of my predecessors for most of my life," he continued. "Four hundred myuths ago, at the height of the period of great heat the average temperature was 110 units. In Evere's time it was 75; in Desgrave's it was 70. Now it has dropped to 60. In another hundred myuths it will be less than 40."

Someone rose in the back of the chamber. Deriae could not tell who it was. "What proof do you have that the present trend will continue?"

"My presentation today is made with the purpose of convincing you of this fact. My evidence is such that a great deal of preparation in physics is necessary to understand much of it, but I will try—"

"You will try to explain it in language we morons can comprehend," the Councilman interrupted in a hostile voice.

"No, I merely meant—"

"Don't bother to explain. We know your opinion of the Council."

"I am only saying that the Council's field of expertise is different than mine. It is not possible for you to fully understand every aspect of

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every problem which you are compelled to discuss." But Jans knew he had not healed all the wounds he had made. They had sensed his bitterness towards them and nothing could absolve that. He clenched his teeth. He was not a diplomat.

"There is much evidence," he went on. "When I was twelve I was fortunate to catch a glimpse of something few people have ever witnessed: our sun. The clouds parted for just a moment and from that time on I have been a scientist, though I did not immediately turn to physics. Myuths later I saw the sun again and it had changed; it was considerably smaller and fainter. I know because I measured its disk and compared the data with the famous measurements of Desgrave and Evere. Our sun is about half the size it was in Evere's time!"

"I don't see how the size of this so-called sun of ours affects the temperature," someone interjected.

"Perhaps I gave the wrong impression. The sun is not smaller; it merely appears smaller. This implies that we are farther away from it. Since we owe most of the warmth of our planet to the radiation of our sun, the farther away it is the colder Rangi will become."

"Are you saying that Rangi's heat is not produced internally?"

"Yes, or at least not all of it. It is true that for a long while we depended upon the internal heat that the people we call the gods stored in Rangi somehow, but that heat is almost gone, and most of our warmth now comes from the sun."

A young Rangin stood up, flexing his wings as he rose. Jans recognized him as a member of a group informally known as the Venerators. At least twenty Council members openly admitted that they adhered to the doctrines of the group, and Deriae suspected that as many as thirty percent of the Council belonged to the secret sect. The Venerators believed that after the gods created the world fifteen hundred myuths ago, they retreated beyond the golden door of the Chamber of the Gods, from which they could eternally watch over the affairs of Rangi. Deriae knew that to the most devout of them, attempting to open the Chamber would be an act of desecration.

And after the Venerators finished with him, the Destructionists would attack. And then the most powerful foe of all—Aviam Winsz, the Council's Science Adviser.

"Now you are claiming that this object which gives us light and heat is one of those stars which Desgrave hypothesized," the young Rangin said.

"I consider it a fact."

"And these stars fill the sky?"

"Yes."

"Then why have I never seen one?"

"You have not looked."

"Well, where should I look?"

"You answered that yourself,"

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Deriae said, extending a hand towards the ceiling. "At the sky."

"And when should I look?"

"Every minute that you can. And then maybe you will see a star or two in your lifetime. Maybe—if the clouds part."

"And yet you've seen the stars a dozen times and the sun twice?"

"I see that you have read at least one of my papers. Yes, I have, but I have been lucky."

"And from those few observations you have concluded that Rangi is in danger?"

"It is evidence, with Desgrave's hypothesis to build upon."

"I, of course, am familiar with that hypothesis, but why don't you explain it? Other members of this Council may not have wasted their time reading it."

Deriae felt rage begin to bubble within him. "Desgrave . . . theorized that the universe consists of an unfathomable number of radiative bodies he called stars, separated from each other by immense distances. Around some of these stars circle one or more planets which are capable of supporting life."

"And what keeps these planets circling their stars? Giant ropes?"

Several Councilmen laughed softly.

"Have you ever read my theory of mass attraction?"

"No."

"I believe that every body in the universe attracts every other body, the strength of that attraction varying with the inverse of the square of the distance."

"You mean that I'm attracting you?"

"Yes," Deriae said slowly, choosing his words with care. "But because Rangi is so much larger than we are, the attraction between us is overwhelmed by the attraction Rangi has for each of us individually. Of course, Rangi is in turn temporarily under the influence of the sun. However, my calculations show that our planet is quickly moving away from the sun and will soon escape its grip. It is a problem in simple geometry. Rangi's orbit is a hyperbolic one, an open orbit. In other words it is the shape of one branch of an ordinary hyperbola. Now the hundred myuths of great heat occurred when our planet passed through the vertex of its orbit and was closest to the focus, the sun. Now we are moving away from the sun. And we will never return—unless we change Rangi's orbit.

"At one time the internal heat of our planet was great enough to enable us to survive without a sun, but that is no longer true. The heat stored by the gods is almost gone. The time will come when the rays of the sun become too weak to heat Rangi effectively. Already they are very feeble. When this happens Rangi will freeze. And we will eventually die."

"I see."

Deriae sensed a growing hostility in the Council.

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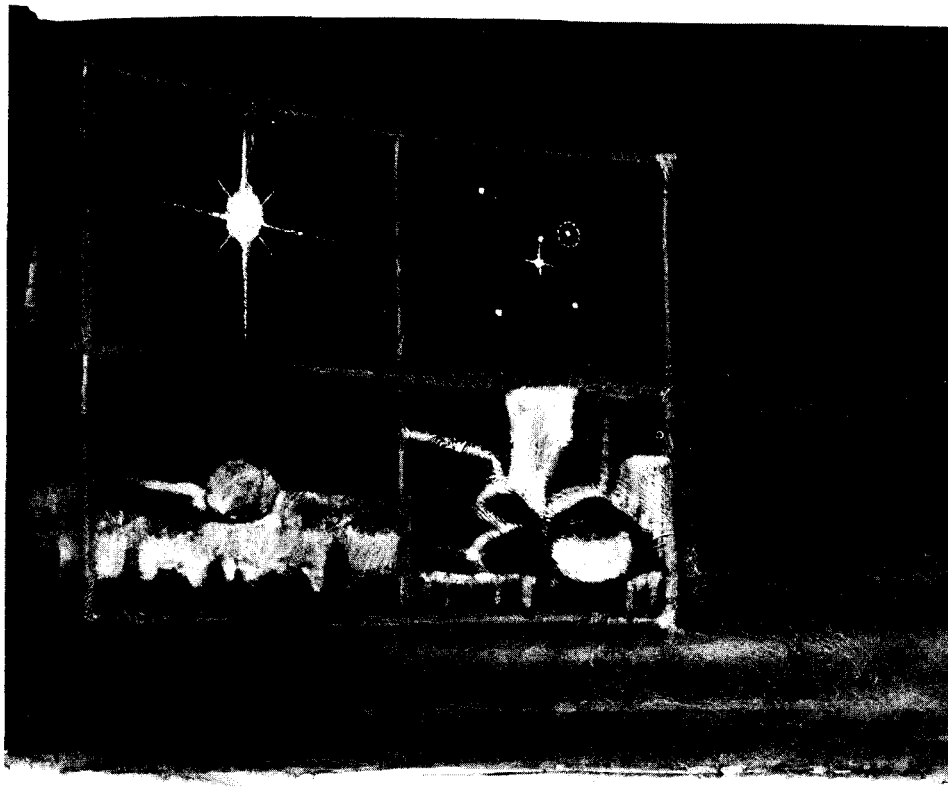

"And you believe this?" the young Rangin queried.

"It is not difficult to believe the truth."

"Don't you see any contradictions between your theory and what we know about the history of the universe?"

"Our *planet*," Deriae said.

"This planet is the universe."

"That is your theory. Any contradictions between your theory and mine should be examined closely, studying the evidence supporting each position." Deriae felt a flicker of the hope he had possessed before entering the Council room. Surely the Council would recognize the truth!

The Venerator nodded. "I will state my position, since the Council has heard yours."

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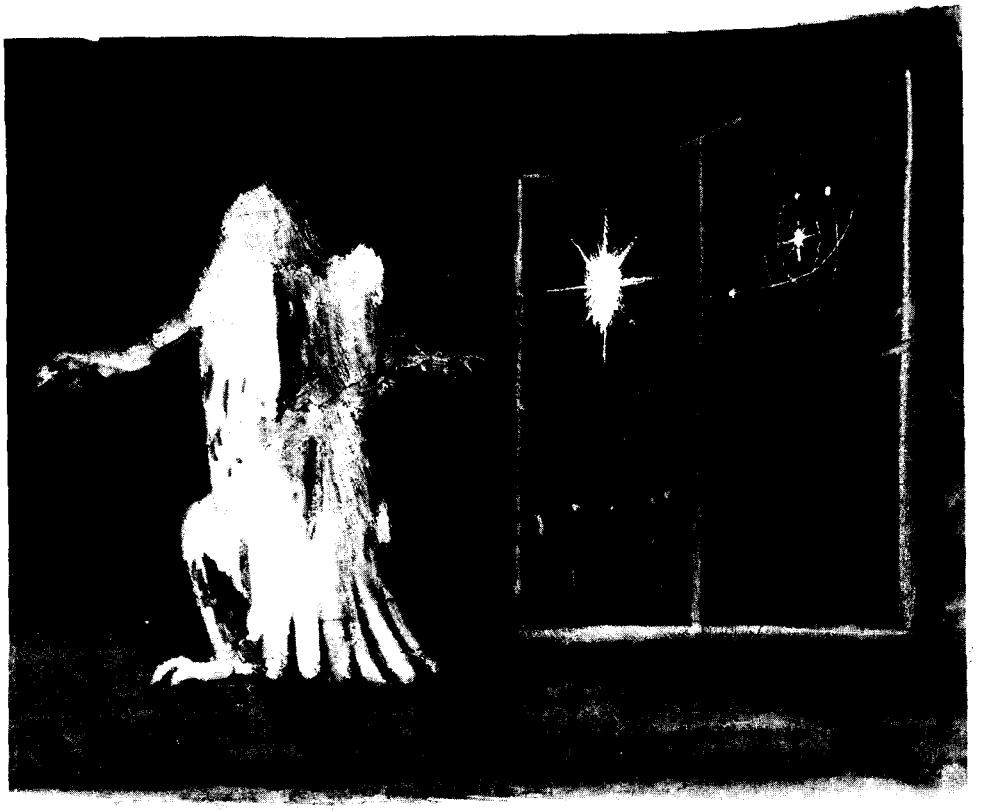

Deriae started to protest but the President cut him off. "Councilman Mhuiae is speaking."

"As everyone knows, our written records go back one thousand four hundred fifty myuths, though it is true that we have found a few undated papers which appear to be older. There is evidently only a slight difference in age, however. The dated ones tell us of an era of darkness prior to that age. Some of the undated ones mention the gods, the Chamber of the Gods, and the decree that the Chamber should never be opened.

"It is obvious to any thinking person that the 'Era of Darkness' refers to the time before the creation of Rangi and the various creatures on it. We do not know the exact date of

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the creation but it could not have occurred much earlier than one thousand four hundred fifty myuths ago."

There was general agreement in the chamber as Mhuiae finished his argument.

"I agree with your facts," Deriae said, "but disagree with your conclusions." He gazed at Mhuiae. "Isn't it true that the records you claim are undated actually contain undeciphered arrangements of numerals which possibly could be dates?"

"The numerals make no sense. They are far too large."

"What you mean is that they are too large to support your theory. If a fact doesn't agree with your theory, you discard it and ignore it.

"I believe that Rangi is far older than fifteen hundred myuths. I believe that these numerals *are* dates, but that they were measured from a point in time before even the Era of Darkness you speak about."

"And what was before the Era of Darkness?" Mhuiae sneered.

"A period of light similar to the present one. Let me explain. My calculations show that Rangi has been in orbit around this sun for about fifteen hundred myuths. There is no clear point of demarcation but the figure I have given is quite sufficient for our purposes. It is identical to the one you give for the age of Rangi.

"In any event, the conclusion is obvious: Rangi came from another sun. How or why I do not know, but we are here and that is evidence enough. The so-called 'Era of Darkness' was simply the period when we were between the stars." Deriae paused and President Asderw said:

"Perhaps it would now be appropriate to hear from the Council's Science Adviser."

There was a hiss of ascent from the Council as Aviam Winsz strode to the podium on the speaker's platform. Now Deriae was behind the right podium, Winsz behind the left, with the President in his chair between them.

Jans looked out towards the audience and the pounding of his heart became like a funeral drum, heavy and mournful. Once he and Winsz had been friends. They had met while in training at the Academy of Verniae. Deriae had been trained as a chemist but after twenty myuths of work in the field his interest waned and he returned to the academy to study physics, which Winsz was also studying. Several of his discoveries in chemistry had provided him with a life-long wealth: he synthesized three new materials for clothing, all of which were strong and nonflammable. He also was the first to make an orange dye that did not fade or run. But his mind kept returning to that flash of blue-white he had seen in the sky when he was twelve. And, therefore, when he noticed that competition had opened for a scholarship to study under Brensz, a disciple of Desgrave, Deriae returned to Verniae and eventually was the chosen student. The only problem was that

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Winsz had spent his entire life preparing for the same opportunity and he never forgave Deriae for depriving him of his right. It was especially difficult for Winsz to accept since Deriae had finished training twenty myuths earlier, was so much older, and indeed was not even a physicist. Since that time Winsz had been a bitter foe of the theories of Desgrave, as well as those which Deriae introduced.

"Adviser Winsz," the President said. "What is your opinion of Mr. Deriae's hypothesis?"

Winsz smiled coldly at Deriae. "As everyone in this Council room is aware, I do not adhere to all the beliefs of the Venerators. I for one, doubt that the gods ever existed. What evidence do we have? I believe that they are a myth and not a reality. On the other hand, I do accept Councilman Mhuiae's argument that Rangi's creation took place approximately fifteen hundred myuths ago. I see no reason to think otherwise. Mr. Deriae's contention that Rangi has existed for longer than that has no basis in fact. However, I do have a question to ask of him before I proceed any further."

"Go ahead," the President responded.

"First of all, assuming that you are right in your belief that Rangi is in danger, what do you propose to do about it?"

"Before I answer that question, I would prefer to present additional evidence to support my theory."

"You have had sufficient time to do that," Winsz said.

"I have had the time, but not the opportunity. Is a few more breaths so much to ask?"

"Please answer the question," Winsz said.

"But I am not ready." To answer the question now would rule out any chance he had of presenting additional evidence.

"Answer the question," the President ordered.

Someone rose quickly in the back, but Deriae did not recognize him until he heard the voice. "I object to the ruling," Sjane said. "It is not Mr. Deriae's fault that he has not completed the presentation of his case. Others have taken up his time. I cannot agree with his theory, but I do believe we owe a person of Mr. Deriae's nature more of a chance to persuade us than we have given him."

"You were not recognized by the President, Councilman Sjane," Asderw chastised. "Please refrain from any further outbursts of this kind." He turned towards Deriae, who was numb with surprise from Sjane's attempt to help. "Answer the question, Mr. Deriae," Asderw said.

You already know the answer, Deriae thought. *You know that if I tell the answer now that I have no hope at all.*

Yet he heard his voice begin to speak. "I have no actual plan, only a suggestion. If Rangi is to be saved,

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its velocity of recession from the sun must be reduced. I do not know how to accomplish this but such a task should not be too difficult for a planet with the capability of crossing interstellar distances. There must exist a means by which we can do this, and there is only one reasonable place to search for this means."

"And that is?"

Deriae hesitated. His hope was gone now, but he still could not bring himself to speak.

"Mr. Deriae?" Winsz insisted.

"The Chamber of the Gods," Deriae said at length.

And suddenly the Council room was no longer quiet. But the noise was not very loud, only a buzz of voices, and Deriae knew that the Council did not realize what he wanted to do. Only three people were aware of the implications of his suggestion: Asderw, Sjane . . . and Winsz.

"The Chamber of the Gods?" Winsz exclaimed. "Surely you don't suggest that we open it?"

"Why not?" Now he almost had to yell to make himself heard above the roar. "I feel that it should never have been sealed; surely those we call the gods did not intend for this to happen. Somewhere in the ages when Rangi was between stars, fear overcame our people and we sealed it."

"Who are you to say what the gods meant for us to do, or not do?"

Deriae paused, then plunged ahead. "I do not believe that the gods were gods at all. They were merely members of a race that was far more advanced than we were or are, a race from another world whirling around another sun. They conquered space and their technology made them seem like gods to us. We were in trouble and they helped us because we were unable to help ourselves. But someday, if we survive the present crisis, the miracles that they performed will be within the realm of our technology. Of course by then, who is to say what heights their civilization might have reached. They may still seem like gods to us."

"That is absurd," Winsz retorted.

"It is heresy!" Mhuiae shouted.

"No," Deriae said slowly. "It is merely the truth, and that is the worst thing of all, isn't it?"

The Council growled in response, a low rumbling which swept through the chamber, a wave of unspoken anger.

Jans waited. The rumbling was too loud for his suddenly weary voice to overcome.

Could he have presented his hypothesis better? He had made several mistakes, but after all, he was a physicist, not a Councilman: his job was to discover, not persuade. And a great deal of persuasion was needed in this case. Tradition was a force as strong as the attractive force which bound the universe together. Tradition could not be overcome easily. His case might be more readily believed if Rangi lacked its white fur of clouds. Then the Council could see

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the stars at night and the sun at day and perhaps they would believe him. Perhaps.

But as he thought, he remembered that once tradition had been broken. Somehow the gods had persuaded his ancestors to forsake their own sun and adopt this new one. The gods had persuaded the Rangins to leave their surface homes and flee beneath the ground, into Rangi's warm and welcoming bowels. But the gods had seemed all-powerful, and he was not. That was the difference.

The roar in the room went on, and so did his thoughts.

The journey was long. First the clouds turned dark, then they ceased to exist at all. If anyone had strayed above the ground he could have seen the stars in their unfiltered glory. Perhaps someone did. But if so, he left no records, and no one believed in the stars now. At least, very few did.

Eventually the clouds came again. Perhaps they thawed out from the frozen masses on the surface, or perhaps some machine of the gods created them to preserve the integrity of the planet. But once more they existed and began to glow. Heat started to frolic on the surface once more, dancing to the nearly forgotten melody of light. The music crescendoed, building to a roar of sullen fire five hundred myuths ago. And now the symphony was in its final movement, playing out its last few chords. And when the music ended, so would all life on the surface of Rangi. And later, when the cold penetrated beneath the surface and the food vanished, so also would all life. Rangi was not prepared to make such a journey again.

The rumble in the Council room was fading, replaced by an expectant silence. They were waiting. Deriae, though, said nothing. At length, Winsz gathered his strength and challenged Jans again.

"Mr. Deriae, what you have suggested amounts to destroying one of the traditions our society is built upon. It seems to me that we should consider your proposal for some time. You've hit us with a great deal that is new. You can't expect us to be convinced so soon." He turned to face the Council. "I suggest that we form a Permanent Committee to study Mr. Deriae's proposal." There was a murmur of assent again.

Jans swallowed twice. He had been anticipating this, but even so, it was almost more that he could bear. A Permanent Committee would mean the end of his proposal for all practical purposes. Once formed, such a committee rarely met more than once every ten myuths to consider new data. If a member died, his oldest son inherited the position. It was a method of keeping a Council seat within a single family. With a great deal of luck it would be only a hundred myuths before action could be taken. And by then Jans realized that he would be dead and his argu-

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ment lost, because there was no one else who would carry it on.

"There is not enough time," Deriae said suddenly to the Council. "It may be too late already." His patience was gone.

"That is only your opinion," Winsz replied.

"I am the expert in the matter."

"We cannot rely on your opinion alone."

"It will be too late!" Jans pleaded.

"We will take a vote."

"Let me explain why—"

"You had your chance," Winsz said coldly. He turned to the President. "I ask you to refrain our guest from further argument."

"But I am not finished!" Jans implored. "There is a great deal that remains to be said."

"You can explain it at the first meeting of the Permanent Committee," Winsz said with a slight smirk on his face.

"I must—"

"Mr. Deriae," the President threatened, "if you do not restrain yourself you will be forced to leave the Council room before the vote."

A smug look crossed Winsz's face.

Deriae glanced around the room. No one that he could see showed an expression which strongly disagreed with the President's warning. But someone was standing in the back of the room. Sjane again.

"I'm ashamed of this Council," Sjane said calmly. "You've let one old man scare you so much that you fear to let him finish his speech."

"You have not been recognized," Asderw snapped.

Sjane ignored him. "One old man, and suddenly you—all of you—are scared out of your feathers. When I came here this afternoon I was convinced that Jans Deriae was losing his wits. Now I'm having second thoughts. And it wasn't Deriae who put doubts in my mind. Not at all. It was you—"

"Councilman Sjane!"

"Yes, you cowering Councilmen. Only the truth is capable of driving so much terror into so many hearts. Only the truth. Perhaps he's right after all." Then Sjane turned and swept out the door, leaving the Council stunned.

Jans felt good. It had been myuths since he had felt this good. It was an ephemeral feeling, so quickly gone, but the memory lingered. He was defeated, but he was no longer alone.

"We will vote now," the President said. One by one the names of the Council members were called. And then the final tally was read. Sixty to twenty-two, sixteen abstentions. It hardly mattered, Deriae thought, with silence in his heart. Silence—and the yawning chasm of despair which threatened to swallow him into its shrouded eternity.

"A Permanent Committee will be set up to investigate the problem, if there is one," the President said, his voice calm now, victorious.

A haze appeared over the chamber, but after a moment Jans realized that it was in his own eyes. He

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shook his head and the chamber undulated with the rhythm of his heart. His feet and hands suddenly felt numb and cold. But it was not the coldness caused by a drop in temperature; it was a kind of coldness he had never felt before, a coldness that seemed to be nibbling its way up his arms and legs towards the trunk of his body. And then abruptly his mind cleared and he knew what he had to do.

With a hoarse cough he staggered from the room, leaving the Council to pick its Permanent Committee, and down the corridor to the lift. Several people standing in the hallway asked him if he needed help but Deriae pushed them away.

The door to the lift was open, and he went in, pushed the bottom button and let out a breath of relief. He gazed around him with new awareness. Everything here—the lift, the city, everything—had probably been built by the gods. How could anyone expect savages thrown into a world of civilization to become instantly civilized?

Then pain chewed at his heart with sword-sharp teeth and he forgot almost everything. He sank to the floor and his head reeled as the interior of the lift twinkled with fiery splashes of light.

The lift jarred to a stop and Deriae concentrated and managed to climb to his feet. A long corridor gaped before him, like the throat of some primeval monster. With trembling feet he hobbled to its end and stared with bleeding eyes at the blank golden door. He pulled a gun from his pocket and fingered its black metal body. He lifted it and aimed. And fired. Twice. The blank plate in the middle of the door fell off, shredded by the bullets. The golden door stared at him with two newly created eyes. Jans pushed and the door swung open.

The room was dark and smelled old. Multi-colored fireflies of light danced on panels around the room. As he stood near the door the darkness vanished in a burst of light. The light did not come from the ceiling, or the walls, or anywhere that Deriae could see; it merely existed and filled the room.

On the left wall four pictures moved, each to its own rhythm. Jans stared in wonder. Once, when he was very much younger, he had suggested the idea of moving pictures, but everyone shook their heads and called him a fool.

The picture in the top left corner was a star, a star between yellow and orange in color, a star throbbing with life. A fiery halo around it flickered constantly, licking deep into the darkness of space. The second picture also showed a star, evidently the same one—at least the color was the same—but on a smaller scale this time, surrounded by five tiny disks against a background of faint diamonds. The second disk from the star was circled, and as Deriae watched, the star exploded and

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flashed out to engulf the five planets. When the star had receded from the space it had invaded, the first three planets were gone.

The bottom left picture showed the surface of a bright verdant cloud-covered world alive with Rangins living in grass-roofed houses. Suddenly work and play stopped and everyone stared at the sky. From the shroud of whiteness dropped a silver globe, plummeting towards the ground as a Rangin with a broken wing might fall to his death. But just before the globe was to hit, it stopped instantly and hung suspended in the air, with no apparent support. Then the aliens came out.

There was little doubt in Jans's mind that he was seeing the origin of the legend of the gods, and he could hardly blame his ancestors for the interpretation they gave to the visit of this strange race.

They were bipeds like the Rangins; they had two arms and two legs, but they had no wings—and no feathers either as far as Jans could perceive. Their bodies were covered with a thin metallic-looking uniform and it was impossible to see most of their skin. However, the skin around the face was very pale in one individual and very dark in another. Whereas the heads of Rangins were long and narrow these people had heads that were more rounded. They walked slowly down a ramp and abruptly the picture began to repeat.

The fourth picture was one of construction. Giant chasms appeared in the surface of the world and were slowly filled in with honeycombed cities. After a while this picture also began to repeat.

Deriae focused his attention on the right wall, which also bore picture screens. Immediately he noted a similarity. The top left screen also burned with the glare of a star. However, this star was almost white, with only a faint tinge of blue, and Jans instinctively knew that this star was larger, much larger and much brighter, than the yellow star on the left wall. And though he had seen it only twice in his life, he recognized that brilliant whiteness.

The second picture showed another system of planets, with the white sun at the center. Three tiny worlds were visible, and the outermost was circled. There were dotted ellipses passing through the two inner planets and then around the star, obviously marking their orbits. The orbit of the outer one, however, was a hyperbola, dipping close to the star at the vertex and then away on both legs until reaching the edge of the map. Part of the dotted hyperbola blinked regularly—since it included the vertex Deriae concluded that this was the part traversed.

The last picture showed the room Deriae was in and there was only a blank space where the fourth picture should have been.

But the wall facing the door contained the most wondrous picture of all. Millions of diamonds blazed

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against the velvet background of black. Some were red, some blue, some yellow, and they were flung across space in no discernible pattern. Deriae cursed the clouds which had denied him this sight for his entire life. There were so many! Even Desgrave had not predicted this many.

Two stars were circled and another possessed a square of light around it. The two circled stars were connected by a horizontal line and near the star on the right was a very tiny blinking dot. Only when it flashed was it visible at all.

Deriae stumbled over and sat down in a chair in front of the control panel under the pictures on the right wall. His head throbbed and his veins felt empty. He had little strength. He groped for his pills and felt a moment of panic. Where were they? Then he found them and hastily swallowed one.

After sitting for a while the webs in his mind were swept away and suddenly he understood. The eternal cycle of life. Birth and death. Everything in the universe had to follow nature's rhythms. There was a great variance in time, but in the end all things had to die—even stars. And sometimes, like animals, stars became diseased. Excitement pulsed through him as he pursued this new line of thought.

The star that once brought light and warmth to Rangi had become diseased and with stellar fury threatened to destroy the entire planetary system. And except for a race of benefactors it would have. They somehow convinced the Rangins that the death of Rangi was inevitable if it remained where it was. The pictures on the left wall showed Rangi as it was and as it would have become had it remained in orbit around that sun now so far away. The beautiful tapestry of the universe which hung across the center wall showed both the sun which was left behind and the sun which warmed Rangi now, as well as the path taken between the two. And the sun with the square of light around it? Possibly the far-distant sun which the aliens called home.

In a manner similar to the ones on the left wall, the ones on right wall showed Rangi's present orbit and the new sun around which it orbited. The hyperbolic nature of the orbit was clearly visible and anyone with even an instinct for mathematics could see that Rangi was quickly leaving its sun behind.

Deriae looked closely at the third picture, the view of the control room he was in, and noticed that in the picture the panel in front of him had circles around some of the controls. A small white button had one circle, a large black-handled lever two circles, and so on, up to six. Were these the controls needed to change Rangi's orbit?

He gazed at them. He could foresee no harm in testing them, as long as he followed the order prescribed. And there was the chance that he

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could save Rangi, even without the Council's approval.

He punched the button with one circle. The fourth screen flashed on with a blaze of light. It subdivided instantly into four smaller pictures, the top left one contained a message printed in Rangin; the other three were blank.

ON A ROUTINE EXPLORATORY MISSION, WE, WHO COME FROM A FAR DISTANT WORLD CALLED EARTH, FOUND THAT YOUR SUN WAS ABOUT TO EXPLODE. WE TOOK STEPS TO GUARANTEE THE SURVIVAL OF YOUR PLANET, AND WE HOPE THAT BY NOW RANGI IS IN A SAFE ORBIT AROUND ITS NEW SUN. THE FOLLOWING INSTRUCTIONS WILL INSURE THIS.

1) WHEN RANGI APPROACHES ITS NEW SUN, IT IS IMPERATIVE THAT THE VELOCITY OF THE PLANET BE DECREASED FOR RANGI TO ACHIEVE A CLOSED ORBIT. IF THIS DOES NOT OCCUR, RANGI WILL NOT ORBIT THE STAR BUT RATHER SWING AROUND IT AND ESCAPE. THIS WOULD MEAN CERTAIN DEATH FOR YOUR PEOPLE. THE COMPUTERS IN THIS ROOM ARE DESIGNED TO UNDERTAKE THIS VELOCITY CHANGE AUTOMATICALLY. HOWEVER, OUR MACHINES ARE NOT INFALLIBLE AND THERE IS A POSSIBILITY THAT ONE OR MORE MAY HAVE MALFUNCTIONED. IN THIS CASE, THE MALFUNCTION MUST BE LOCATED AND THE CHANGE PERFORMED MANUALLY.

2) PULL LEVER WITH TWO CIRCLES DOWN APPROXIMATELY HALFWAY. IF LEVER DOES NOT MOVE, DO NOT FORCE IT. THIS MERELY MEANS THAT ALL CIRCUITS ARE IN WORKING ORDER AND YOU MAY IGNORE THE REMAINDER OF THIS MESSAGE.

Deriae pulled the lever. It moved easily, confirming what he already knew. Two of the other small screens came alive, one with additional instructions, the other with mathematical tables which Jans did not understand immediately. But he did understand one thing. For all its technological prowess the race which saved Rangi could not build perfect machines. Sometime during the long journey, a malfunction had occurred, and now he—Jans Deriae—had to correct the mistake.

He read the new instructions carefully. They appeared fairly simple. One of the formulas given seemed to indirectly confirm his theory of mass attraction and he felt a swell of pride.

Footsteps in the hallway shattered his concentration. They became louder and louder and Deriae turned towards the open door. The guard, if it was a guard, had not yet discov-

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ered the intrusion. Deriae wondered if he should close the door and hope that the bullet holes would not be noticed. No, his only chance was to complete the calculations quickly. He estimated that he had twenty breaths before the guard came upon the open door. He whirled back to the control panel.

But he was wrong. It was a cruel fate which teased him this way, letting him approach to within moments of his goal, only to jerk the opportunity away. He needed so little time now.

The guard was running by the time he arrived at the chamber. Fear glazed his eyes and he trembled on the portal, making no move to enter.

"You . . . you must come out of there," he stuttered. He waved his gun at Deriae.

"Come in and take me."

"It is forbidden."

Jans did not bother to refute the guard's logic, and when the guard saw that Jans was not going to come out, he armed the firing plate of his gun. Jans could tell from the faint click that the weapon was not a powerful one, but at its present range it would still be lethal.

"Do you think the Council would approve of firing a bullet into this chamber?" Deriae asked calmly.

The guard hesitated, then turned and fled. Deriae instantly was back facing the control panel. The guard had gone for help. That would mean a reprieve, but it would be a short one.

Everything faded from his mind except the instructions on the screen.

First he had to locate the malfunction. He pulled the black-handled lever on the control panel, the lever which was circled twice in the picture before him. A small red light came on beside the lever, then went off. Deriae glanced up at the fourth screen again.

MALFUNCTION LOCATED. TEMPERATURE SENSORS ON SURFACE INOPERATIVE DUE TO LONG EXPOSURE TO COLD. PLUG PRESENT AVERAGE TEMPERATURE OF RANGI INTO RED KEYBOARD.

Deriae examined the keyboard. There were two rows of ten numbers each, if zero was counted as a number: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Base ten. The Rangin system. He wondered briefly if the builders of this room used a system based on ten. But he had no time to consider the thought further.

Deriae punched a 6 into the first column and a 0 into the second, then waited. The message on the fourth screen changed again.

IF GREEN LIGHTS ON CONTROL PANEL FLASH, PULL LEVER BETWEEN THEM. THIS WILL INITIATE AND LOCK CONTROLS FOR ORBITAL CHANGE. IF LIGHTS DO NOT FLASH, OTHER MALFUNCTIONS MUST BE TRACED.

The message held on the screen momentarily, then the entire fourth panel went blank.

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He sighed, and began his wait. He felt a slight disappointment at the simplicity of it all. He had not even had to use the tables which had appeared.

The control panel remained inert, waiting for the right signal. What if there were other malfunctions besides the failure of the temperature sensors? How would he know how to find them? What if there was a malfunction in the control panel. Perhaps all his efforts were in vain.

The green lights still had not come on when voices drifted in to him from the hall. He recognized one of them as belonging to Sjane and then they were upon him. Someone grabbed him and tore him from the control panel, spinning him roughly to the floor. Time began to blur.

"You were forbidden to come in here," Sjane remarked, but his voice was calm, not angry. "You have disobeyed a decree of the Council."

Deriae thought of the race who had built this room. They had extended the hand of friendship and tried to save Rangi. But they had failed—at least one of their machines had failed. And that was all it took, Deriae thought, for the Rangins were unwilling to save themselves.

Pain shot through his head, jabbing at his skull. His mind wanted release from this nightmare. All his striving had been in vain.

Pain seized him once again. He needed one of his pills. But he dared not take one here. Or did he? He might die if he did not.

He fought the weakness which was attacking him and raised his head. There were three people in the room, Sjane, the guard, and Avaim Winsz. The latter had probably been responsible for the rough greeting.

Deriae blinked. Perhaps he could chance one of his pills. None of the three was looking at him. All were absorbed by the viewscreen: Sjane in wonder, the guard in fear, and Winsz in bitter anger.

Deriae reached into the pocket of his cloak and pulled out the bottle of pills, trying to hide them with his body. He plucked one out and jammed it into his mouth. It took three swallows to force it down.

Suddenly he realized that Sjane was staring at him. Had Liez seen? The blank expression of Sjane's face told Deriae nothing.

"What do all these pictures mean?" Sjane asked.

Strength was returning slowly. "T—they confirm the theory I explained at the Council meeting."

"But—"

"Nonsense!" Winsz exploded. "He's senile. How can you believe a word he says?"

Deriae wobbled to a standing position and leaned against the end of the control panel. Winsz was in front of the lever and there seemed to be no possibility of beating him to it, even if the lights came on in time. Jans could envision them flashing in vain to an empty room as he was dragged away.

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"Those are your gods," Jans said, pointing across the room to the screen showing the descent of the aliens from the clouds. As he had hoped, Winsz also turned to glare at the indicated picture. Jans continued to watch the lights on the control panel as he went on. "Yes, they came from the heavens, but in a ship, a ship the like of which we will someday be capable of building if we survive that long. It—"

And suddenly words no longer mattered. Only actions did. The green lights were flashing.

Winsz saw them as soon as Deriae did. The Councilman backed slowly away in horror, his mouth gaping open, his crest rippling.

A little more, Deriae thought. A step more and I will be able to reach the lever before he can stop me.

Jans felt the bottle of pills in his hand and clenched them. It was his one chance to pull the lever because already curiosity was replacing horror in Winsz's mind, but Jans knew it would be his death sentence. Even though he was old, with the aid of his pills he could expect another ten or twenty myuths of life, perhaps more. He had so much work left to do. There was the relationship of the dyplres and mhinreqs . . . and the Rangins. He sighed to himself. Yet what use would such knowledge be to a world condemned to die?

Jans felt the small glass bottle again, then silently extended his open hand towards Winsz. The Councilman's attention was seized and he turned from the panel.

"What—"he began, reaching for the pills.

in times to come . . .

Imagine living on a planet where the crust hasn't solidified yet, where the oceans are vast seas of molten lava, where fifty-kilometer-long slabs of granite are used as floating cities. S. Kye Boult has done just that in next month's lead novelette, "Collision Course." Cover is by John Schoenherr, and it's "hot!"

The science article is about the future of automobile engines. While many new types of engines are being talked about, the old internal combustion engine (with some improvements) is far from finished!

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Deriae dropped the bottle, and as Winsz groped down after it, Jans jumped for the lever. He snapped it into place just before Winsz recovered and hurled him to the floor.

The room blurred and Jans wondered why Winsz did not hit him again. It did not matter, though. He looked up as his eyes began to focus and saw the new message on the fourth screen. He glanced at Winsz. The Councilman was staring at the message, the blood vessels over his eyes pulsing with anger. Deriae saw that all ten of his talons were extended. Winsz's eyes flared wide and he grabbed the lever and tried to push it back to its original position.

But somehow Deriae knew that no Rangin would ever move that lever again.

"You've killed us all!" Winsz shouted. He glared at Deriae. "This chamber will be destroyed, I'll see to it." He whirled and strode from the room. The guard, grabbing at any excuse to flee, followed him.

Jans seized the instrument panel and pulled himself up. He swayed as dizziness overcame him, and would have fallen, but Sjane was there to steady him until the feeling passed.

"Do you need another pill?" Sjane asked.

"No, I—" He turned to look at his friend. "I thought that Winsz—"

"I picked them up while the two of you were struggling. Now I know why you so adamantly supported the move to legalize life-sustaining drugs."

Deriae nodded, and took the bottle from Sjane's hand. Sjane was smiling.

"Winsz will no doubt remember them when he recovers from his rage," Sjane went on. "I will produce a substitute bottle of pain-killers or something similar if he asks."

"Thank you, but I am not sure it matters," Jans said.

"What? I don't understand."

"I will try to explain." Deriae looked at his friend, searching those pale gray eyes in advance for the answer to the question he was about to ask, but could not find it. "Do you believe me now?" he asked at length. "Do you believe I was right about this chamber?"

Sjane waved his hand towards the pictures which still danced on the walls. "Only Winsz could fail to understand now, and someday perhaps even he will believe." He pointed to the aliens. "They are strange creatures. I would like to meet them."

"We will," Jans replied. "I mean *we* are too old. But someday our races will meet again, I know it. That is enough for me. I will gladly use the additional myuths you have given me by returning my pills; there is always work to be done. But the work which remains can be done by others; what has been done could only have been done by me. Every life has a purpose; I accomplished mine tonight." He smiled slightly and turned to stare at the message on the fourth screen one more time.

REQUIRED ORBITAL CHANGE INITIATED. ■

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out, wit!

As was pointed
out long ago,
"It ain't what you say,
it's the way
that you say it!"
that counts.

HOWARD L. MYERS

[redacted]

Department of Physics
Grandview University
Grandview, Ohio
November 6, 1975

D. R. Dayleman, Editor
North American Physical Journal
Adminster, Virginia

Dear Dan:

Other commitments will keep me from attending the annual NASP meeting in Chicago in January. Sorry I must pass this up; we old hands enjoy these opportunities to congregate and chat, do we not? Give the others my regards and regrets.

You may remember the name Jonathan Willis. He is a young man who did his doctorate for me here at Grandview and who was listed among the co-authors of some of my research reports published in the NAPJ. I regard him as one of the most promising youngsters in nuclear field theory. In some respects he is rather immature and irrepressible, for which his brilliance more than compensates. He is presently associate professor of physics at Mesa State University.

I mention young Willis because I've recommended him to the agenda committee of the Chicago meeting. He's to present a paper on an approach to nuclear generation and degeneration that he has been pondering for some time, and which he tells me he has virtually completed since going to Mesa State. His theory proposes a characteristic, called, I believe, "angular stability," which seems to put the question of whether a given nucleus will fission on more solid ground than a mere

[redacted]

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law-of-probability basis. All I know of his recent work comes from two brief phone conversations with him, the latest of which was yesterday afternoon. Actually, you will have the opportunity to see his paper, and hear him deliver it at the meeting, before I can examine it, judging from my present plans. He was still writing it yesterday, and said he would send you a copy to consider for publication well in advance of the meeting.

Thus, you may consider this a "letter of recommendation" for my very able former student. And I am also aware, of course, that you like to know when a report of extraordinary interest is coming to the *Journal.*

Best regards,
Harmon McGregor, Chairman

North American Physical Journal
January 3, 1976
Department of Physics
Grandview University
Dear Harmon:

A note in haste, as I'm off to Chicago this afternoon.

The Jonathan Willis manuscript did not reach me until yesterday, though it was mailed in mid-December. The postal service becomes continually more atrocious, especially around the holiday season.

I haven't had time to read more of it than the abstract, and glance at the math. It looks most promising, and I'm forwarding it to the referees.

I do find his title, "Back to Alchemy," rather objectionable, but that's easily remedied and not at all unusual. I'm often amused by such efforts of our younger colleagues to find "catchy" titles for their reports. When I make the acquaintance of young Willis at Chicago, I'm sure he and I will be able to find a more reputable title, in keeping with the content of his paper.

All best wishes,
Daniel R. Dayleman

North American Physical Journal
January 20, 1976
Department of Physics
Grandview University
Dear Harmon:

I understand if, having doubtless heard of the debacle in Chicago, you are reticent about writing to me.

Please rest assured of my continued high esteem. No one holds you responsible in the slightest for the dismaying performance of Jonathan Willis. Such things will happen now and then, to the injury of the repute of our profession, and are, of course, not to be tolerated. But matters are best mended not by blaming each other. Rather, we must work together to make sure such offenses are quickly forgotten and not repeated.

Indeed, I admit some responsibility in this myself. Had I taken time to read Willis's paper when I received it, I could have phoned Margoli and warned him to strike it from the meeting's agenda.

I can sympathize with the feeling of shocked betrayal you must be suffering, since your letter indicates you

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had a high regard for Willis. During my own academic career I, too, was disillusioned by my students more than once, although none of them dishonored themselves or our profession in so startling a manner as this.

Again, be assured of my continued esteem and

All best wishes,
Daniel R. Dayleman

Department of Physics
Grandview University
February 14, 1976

North American Physical Journal
Dear Dan:

I got back to Grandview yesterday for the first time since shortly after my last letter to you, having been fully occupied with other commitments in the meantime. A copy of my former student's manuscript, along with your letters and those from other friends who attended the Chicago meeting, were waiting on my desk.

You can appreciate that they were a bitter dose for me. At this moment I'm torn between a sense of personal guilt and anger at the former student. Mostly, I feel the guilt.

I've tried not to slight the task of teaching my students professional decorum. But it is something I've always sought to put across more by personal example than by precept. For this student, obviously a more forceful effort was required of me, and unfortunately was not forthcoming.

Dan, would you do me the kindness of telling me precisely how the meeting responded to the report? And am I correct in assuming no effort will be made to publish a revised version of it?

Best regards,
Harmon McGregor

North American Physical Journal
February 19, 1976
Department of Physics
Grandview University
Dear Harmon:

The response to Willis's presentation can best be described as frigid.

He began with a tasteless ad lib, not mentioning me by name but referring to my suggestion, made to him the previous evening, that the title "Back to Alchemy" be changed. He said he agreed, because "science never marches backward, or at least hardly ever." This drew a scattering of mild chuckles from the younger crowd. Then he offered as his revised title, "Forward to Alchemy." Frankly, I was too stunned by this insolence to note the immediate reaction of others, but I believe my feeling was by no means unique.

From there on Willis followed his manuscript text closely, with results you might well imagine. The most disastrous of his witticisms was the conclusion of his introductory paragraph: ". . . Upon assuming my duties at Mesa State University, I was in position to make fruitful utilization of the scientific method in bringing this research to completion. You know what the scientific method

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is: that's having your graduate students do all the hard work for you."

This double slur, striking not only at academicians but at the high cause to which our profession is dedicated, brought a coarse guffaw from one newspaper science writer. Everyone else, even the younger crowd, sat in stunned silence. From that point on, the entire audience was like a stone.

Of course we've all encountered speakers who, regardless of the seriousness of their subject and the dignity of their listeners, think it necessary to open with a touch of "after-dinner" humor. One need not be a psychologist to observe that such speakers must lack confidence, either in themselves and the value of their presentation, or in the ability of their

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Leo Summers

audience to accept a serious presentation.

But so accustomed have we become to this ritual of the opening jokes that perhaps Willis's would have been overlooked, despite their aspersive quality, had they ended at that point. As you can see from the manuscript, they did not.

I found most objectionable, for example, his use of the term, "the Slide Rule," in referring to his theorem of nuclear degeneration. This is a thoroughly juvenile play on words.

When Willis concluded, we moved on, without questions or discussion, to the next paper on the agenda, and a normal atmosphere was soon reestablished. I had no encounters with Willis thereafter, and cannot say—

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and do not care—how he reacted to his chilly reception.

Fortunately the popular press made little of the episode. I don't believe the reporters present really grasped what was going on. Being members of a craft not noted for pride, or for reasons for pride, they would not be struck by the demeaning quality of the Willis "wit."

As for our foreign guests at the meeting, I cannot guess their reactions, except to presume they were varied. The Russian group in particular had a limited grasp of the English language, and the "jokes" may have eluded them. Of course the foreigners received copies for later translation and study, and I can only hope the Willis brand of humor will suffer in translation. If not, I fear the respect abroad for the American physics community will be dampened.

Obviously any revision and publication of the paper is out of the question, in view of the irremedial scandal its author has brought upon himself. It is best to drop and forget the entire matter. I understand certain administrators and faculty leaders at Mesa State University have already been approached, to acquaint them with what transpired at Chicago. Presumably they will take such steps as they consider appropriate.

I ask you, Harmon, not to blame yourself for this debacle. Remember that undesirable personality traits are formed early in life, long before a youth reaches college age. I dare-say that nothing you might have done would have made much difference, in that regard, in Willis. A teacher should not fault himself for the poor quality of student he sometimes must work with.

All best wishes,
Daniel R. Dayleman

Department of Physics
Grandview University
March 8, 1976

North American Physical Journal

Dear Dan:

Many thanks for your letter of February 19th. I needed your closing reassurances very much, having just received a letter from the former student in question, in which deep bitterness showed through his usual flippance in a manner I found very disquieting. Your words helped me recover my perspective.

I will not quote his letter at length. The gist of it is summed up in his protest: "They acted like I'd told a dirty joke in church!" Of course he is not capable of realizing how apt that comparison is. Impertinence has no place in a gathering of learned persons, striving toward the noble goal of understanding the laws of the universe.

However—and because that *is* our goal—I hate to see the perhaps valuable theoretical content of the paper passed over because of the unseemly inclusions. For that reason I have studied it thoroughly, and find the logic of it apparently sound. And if his proposed and dismally misnamed "Slide Rule" can be verified by ex-

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periment, it could have major technological applications. It might provide an opening to controlled nuclear fusion, as well as to the tailoring of elements alluded to in the paper's title.

The verifying experiments would require use of one of the large, federally-sponsored accelerators. While I'm fairly well-connected in Washington, I am reluctant to request accelerator scheduling for this purpose. My personal association with the author of the paper could make a request from me suspect. Under the circumstances, I would probably accomplish nothing, and might do myself a professional disservice.

Did any of the participants in the Chicago meeting express interest in the real content of the paper, to indicate they may be willing to undertake the necessary verifying tests? Please let me know if you see any hope along this line.

Best regards,
Harmon McGregor

North American Physical Journal
March 12, 1976

Department of Physics
Grandview University

Dear Harmon:

I have just one hope along the line you mention. That is that you'll drop the whole thing. Immediately and completely.

I thought my letters had made clear to you how totally negatively all of us responded to that horrible Willis paper. Not one physicist in that room could possibly have followed the rationale of the report, filled as all of us were with justified and honorable indignation. Certainly nobody expressed the sort of interest you are asking about.

Harmon, for your own sake as well as for the dignity of American physics, let this sleeping dog lie!

Best wishes,
Daniel R. Dayleman

Department of Physics
Grandview University
March 20, 1976

North American Physical Journal

Dear Dan:

I'll heed your advice. And forgive me if I've tried your patience over this affair. I felt it my duty to at least try to rehabilitate my former student and his research findings.

Now that I feel I've done all I can reasonably ask of myself in that direction, I'm very glad to wash my hands of the entire miserable mess.

Hope to see you in Paris in July.

Best regards,
Harmon McGregor

North American Physical Journal
October 9, 1978

Department of Physics
Grandview University

Dear Harmon:

Your piece on spin-ratios is drawing interesting comments and questions from readers. Enclosed are three letters that might be worth publishing with your comments.

Harmon, I hate to rouse a sleeping

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dog that I myself urged you to let lie. However, it has come to my attention that Jonathan Willis, the creator of that unseemly incident at the NASP meeting three years ago, is now teaching physics at Simonton High School which, according to the road maps, is some forty miles from Grandview.

I am not suggesting any particular action in relation to this. Maybe no action is needed; one might say that Willis has found his proper professional level. I must ask, however, if Willis will present impressionable high school students with a reputable example, as a member of our profession?

I hope you'll give this matter some thought, and take whatever action you deem advisable.

All best wishes,
Daniel R. Dayleman

Department of Physics
Grandview University
December 15, 1978

North American Physical Journal
Dear Dan:

Concerning the comments on my spin-ratios piece, I admit myself at a loss for worthwhile answers to the questions raised. Essentially, the questions ask for a reconciliation of my conclusions with those offered in recent publications by various Russian theorists.

I have, of course, gone over the translated Russian reports, and have come away puzzled–as has nearly everyone with whom I've discussed them. The Russians appear to have gone off on some offbeat line of investigation without bothering to tell the world the reason for their departure from the mainstream.

I halfway suspect the presence of a Lysenko brand of physicist, well-concealed and disseminating a politically-inspired dogma the others are obliged to accept. I would not care to say that for publication, as you can readily understand, but it is the only solution to the Russian riddle that occurs to me. Publish the questioning letters if you like, but without comment from myself.

As for my former student referred to, I've made discreet inquiries about him and his present position. The community of Simonton is synonymous with "hayseed" in this section of Ohio. Its high school has an enrollment of three hundred at maximum, of which fewer than twenty percent take the science courses.

I feel we can dismiss the situation as inconsequential. Certainly it is too trivial for me to wish to involve myself in it, and run the risk of personal encounters with this former student that could not be pleasant.

Perhaps he is now on the receiving end of student impertinence, and might profit thereby.

Best regards,
Harmon McGregor

North American Physical Journal
April 7, 1980
Department of Physics
Grandview University

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Dear Harmon:

I regret to inform you that the present currency crisis has forced the temporary suspension of *Journal* publication. Enclosed is your latest manuscript which I am returning not as a rejection but in case you can find another publisher for it—one not caught as unprepared as we were by the sudden economic storm.

Conditions should stabilize in a few months, at which time I would be happy to have this manuscript back. I'm no expert on economics, of course, but I cannot believe the fall of world gold prices can have a lasting depressing effect on the value of the U.S. dollar. That value is, at bottom, based on the ability of our nation to produce goods and services. As soon as the frightened public realizes that, the situation should straighten out quickly.

Nor can the Soviet Union keep dumping gold on the world market indefinitely. Evidently they discovered a very rich mine, perhaps a decade ago, and have been working it ever since to accumulate the amount dumped thus far. Someone more adept than I at analyzing Communist thought processes will have to answer the question, "Why?" They can gain little aside from the enmity of the rest of the world by this action.

Speaking of Russians, what do you make of their claim of a successful power generator utilizing controlled nuclear fusion?

All best wishes,
Daniel R. Dayleman

Department of Physics
Grandview University
April 11, 1980

North American Physical Journal
Dear Dan:

By returning my report you anticipated my desire. I was about to request that you withhold it from publication, because I no longer consider its conclusions valid.

I do not now consider myself at liberty to speculate on Soviet nuclear fusion claims. I will, of course, communicate more fully when I can. In the meantime, please forgive the brevity of this note.

Best regards,
Harmon McGregor

North American Physical Journal
July 9, 1980

Department of Physics
Grandview University
Dear Harmon:

Congratulations!

I've been reading about you in the newspapers, and watching you in television interviews, with much pleasure and satisfaction. Part of my joy comes from your being a personal friend, which allows me a sense of sharing in your resounding success. But more than that, it is a great satisfaction to have the American physicist typified in the public's eye by a figure with the impressive dignity of Harmon McGregor!

Of course I understand now why

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your last letter was so short and mysterious.

Let me add my thanks to those of all members of our free Western civilization for solving the enigma of Russian physics—and by the same stroke resolving the currency crisis and gold glut, and bringing us into controlled fusion. All of which came, appropriately enough, just after the observation of what might otherwise have been our nation's final true Independence Day.

I'm confident the *Journal* will resume publication shortly, and I will be hoping for an early contribution from you.

All best wishes,
Daniel R. Dayleman

College of Physics
Grandview University
July 15, 1980

North American Physical Journal

Dear Dan:

Honor from a colleague is far more dear to me than the loudest public acclaim. Many thanks.

I regretted my mysteriousness, but now that government security measures are no longer justified and are being dropped, you can expect a report for the *Journal* within a month.

In all due modesty, I must point out that I've given man no new discovery. I've merely duplicated the work of some unidentified Soviet theorist. If I were to view the matter from a purely selfish standpoint, perhaps I should be grateful to Soviet secrecy for allowing me the privilege of and credit for giving this discovery to the world.

Oddly enough, Dan, my solution to the mystery was not a formulation that was new to me. It had reposed in the back of my mind for an undetermined number of years, along with the thousands of other mathematical structures a theorist tends to accumulate in the course of his life's work. Just between us, Dan, I fear that figure of "impressive dignity" you mentioned stands revealed to himself as the stereotype "absent-minded professor." How else can I explain leaving so valuable a formulation shrouded in mental cobwebs year upon year?

You may recall the Russian "mystery" was a preoccupation of mine for some time. I once suspected it was the visible symptoms of neo-Lysenkoism, forcing our Soviet colleagues willy-nilly along a crackpot track. Such papers as were being published by the Russians pointed clearly to some undisclosed event that had stimulated the departure from mainstream physics. I devoted much time to the study of these papers, reasoning that, if the hidden event were in the realm of theoretical physics rather than of political origin, then its nature might be definable from clues in the published works that followed it.

The answer came to me in late March—that half-forgotten formulation. In brief, it deals with a predictable asymmetry in nuclear structure that can be utilized as a weak

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point in nuclear binding force. Thus, the binding force can be largely bypassed, rather than overpowered, for the production of fusion and fission processes.

I communicated my findings to the appropriate government officials and the rest, as they say, is history.

Of course the thought occurred to me that, since my formulation was not new, perhaps the Soviets had picked it up from one of my early published works. This could have explained why the Russians were allowed to publish papers containing clues to the secret—that is, they assumed they had no secret since the key formulation was of Western origin. This would raise the secondary question of why they never quoted or referred to the key formulation, but they often "write around" Western contributions as a means of avoiding recognition of these contributions.

The government people working with me have been as interested as I in finding the original of my formulation. All my papers, published and unpublished, and my notebooks as well, have been searched without success. On the chance that the formulation was not mine at all, a similar search has been made of all the physical journals as far back as 1945. Even the theses of my students have been gone over, to make sure I had not inadvertently "borrowed" from one of them.

In short, every source we could think of was examined, and the formulation was not found. Certainly it was never published, and we must conclude that the Soviets discovered it independently. And apparently it is something that occurred to me many years ago, was perhaps scribbled on a piece of scrap paper, and then was discarded and pushed from my mind by more urgent matters.

In any event, I'm happy enough to have remembered the formulation when it was needed, and if the Soviets want to say they discovered it first, I'm hardly in a position to challenge them.

Best regards,
Harmon McGregor

P.S.: Always there seems to be a dark spot in our brightest moments. You probably remember Jonathan Willis, my former student who behaved so badly at a NASP meeting a few years ago. He has been teaching high school in a small town not far from here. A friend of mine who has relatives in that town has just informed me that Willis suffered a mental breakdown of some sort last week. I would guess his brash manner and warped humor were symptomatic of an instability that has brought him to this misfortune. I was genuinely sorry to hear of it, and to realize that at the very instant I was enjoying public acclaim this poor fellow was being stricken by mental agony. It is too bad he had so little to offer as a physicist. A successful career might have shielded him from this. H. McG. ■

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Washington faced the hostility of his erstwhile mentor and would-be father-in-law, plus the skullduggery of evil men who wanted the Transatlantic Tunnel stopped, at all costs. But these paled into insignificance when compared to the awesome task of spanning the midoceanic trench.

HARRY HARRISON

A Transatlantic Tunnel, Hurrah!

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SYNOPSIS

The time is now, the year 1972, but this is not the familiar world that we know. It is a parallel world, a "what if?" world. The golden days of the British Empire seem destined to continue forever. Europe is a collection of quabbling monarchies and New York is the major city in the American colonies. After the Battle of Lexington—which the British won—General George Washington was shot as a traitor. His descendant, AUGUSTINE WASHINGTON, has a secret ambition to clear his ancestor's name, an ambition he never forgets as he works on the construction of the Transatlantic Tunnel.

The genius behind the design and construction of the tunnel is SIR ISAMBARD BRASSEY-BRUNEL.

WASHINGTON, although a fine engineer in his own right, is proud to work for SIR ISAMBARD. But the tunnel is in financial trouble, more backing is needed and the American colonies are looked to to supply the money. With this in mind WASHINGTON is placed in complete charge of the American end of the tunnel construction, a position which makes him more SIR ISAMBARD's equal than employee. SIR ISAMBARD is greatly put out by this and refuses WASHINGTON access to his home and, at the same time, sees to it that the engagement between his daughter, IRIS, and WASHINGTON is broken.

Undaunted, WASHINGTON goes right to work, and flies to the American colonies in the giant coal-fired airplane, the Queen Elizabeth. *While in flight there is an assassination attempt on his life which he foils, killing one of his attackers in the bargain. Apparently great forces are working against the tunnel and he must be on his guard.*

In New York, despite opposition, he is put in charge of the tunnel. The work will go on! Despite assassins, rich Tories who hate the traitorous name of Washington, money and design problems—and the tragedy of his personal life. This, the greatest physical feat mankind has ever attempted, will be done.

A tunnel will be built under the waters of the Atlantic Ocean, linking London and New York City by rail.

Despite the opposition of SIR ISAMBARD, WASHINGTON is building the American section of the tunnel by dropping preformed sections

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of tunnel into a trench dug on the ocean floor. This technique is many times faster than the one used on the British end of the tunnel. After many difficulties the tunnel is built out from the end of Long Island all the way to an artificial island in the Grand Banks that stands at the edge of the slope that drops to the abyssal plain many miles below. As the last section is put into place WASHINGTON begins an epic voyage that will show to the world how fast the American section of tunnel was constructed. Almost as quickly done as the British end—but nearly three times as long.

WASHINGTON leaves the Grand Banks Station in a Royal American Coast Guard hovercraft. This takes him to the end of the tunnel on Long Island. From here he proceeds by electric train back to the Grand Banks Station where a helithopter is standing by to fly him to Gander where a bomber is waiting to fly him to England. But there is sabotage and narrowly averted disaster and the helithopter has a forced landing. WASHINGTON is too late, he never will reach London in time to board the special train in the morning.

But hope is not lost. An English rocket engineer, CAPTAIN CLARKE, readies a mail rocket to carry a human cargo for the first time. At the risk of his life WASHINGTON blasts off for London and reaches the train just as it is leaving. This goes to Point 200, the end of the British Tunnel, an artificial island that is both a sophisticated resort and commercial port. The two ends of the tunnel are done, all is successful, only the last and deepest sections remain to be built.

But all does not go smoothly. SIR ISAMBARD takes back his offer of friendship again, along with permission for WASHINGTON to resume his engagement with IRIS, when WASHINGTON reveals that the tunnel should be built to his plan, not SIR ISAMBARD's. The tunnel will go south to the Azores, then turn west and cross the great mid-Atlantic canyon by means of an underwater bridge.

This work is begun and WASHINGTON has his base in the city of Angra do Heroismo in the Azores. But there is more trouble, accidents, the work goes badly. Why this is so is revealed by a secret visit to WASHINGTON by the master detective, RICHARD TRACY. There is sabotage afoot. A trap is set for the saboteurs and WASHINGTON does his part in setting it.

Part 3

X

Not a sound disturbed the sunlit afternoon, not a word was spoken that could be heard, not a hammer struck metal, no sound of footstep, or motor, or any other man-made noise contrived to break the near perfect stillness. Yes, waves could be heard slapping against the seawall while gulls cried overhead, but these

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were natural sounds and independent of man, for it was the men and their machines who were quiet all through the immense spread of the tunnel works as everyone had ceased his labor and climbed to some point of vantage to watch the drama being played out before their eyes. Every wall and roof and crane had men hanging from it like clusters of grapes, human fruit wide-eyed and silent in the presence of tragedy, staring fixedly at the small hump-backed submarine that was churning its way out of the harbor at top speed. Only at the highest vantage point of the Control Office was there any movement and sound, one man, the radio operator, throwing switches and touching his dials, clutching his microphone tightly, speaking into it, while great drops of perspiration rolled down his forehead and dropped unheeded onto the bench.

"Repeat, this is a command from Captain Washington. Repeat, you must abandon ship at once. Do you read me, *Nautilus*, do you read me?"

The speaker above his head crackled and sputtered with static, then boomed out with an amplified voice. "Sure and I can't read you, you not being a book and all, but I can hear you that well as if you were sittin' at me shoulder. Continuing on course."

A sound, something between a gasp and a sigh was drawn from the listening men while Gus pushed past them and seized the microphone from the operator and flipped the switch to *speak*.

"Washington here--and this is an order, O'Toole. Lock your controls at once and bail out of that thing. I'll have the launch pick you up. Over." The airwaves hissed and crackled.

"Orders are meant to be obeyed, Captain Washington, but begging your pardon, sir, I'm thinking I'll just not hear this one. I've got the old *Naut* here cranked up for more knots than she ever did before in her rusty life and she's going along like Billy-be-damned. The red's still rising on the meter but she'll be well out to sea before it hits the danger mark."

"Can't you damp the pile?"

"Now I'm afraid I'll have to answer that in the negative, sir. When I turned on the power the damping rods just pulled all the way out and I haven't been able to get them back in, manually or otherwise. Not being an a-tomic engineer I have no idea how to fix the thing so I thought it best to take her out to sea a bit."

"Lock the controls and leave--"

"Little late, Captain, since everything is sizzling and sort of heating up in the stern. And the controls can be set for a level course and not for a dive, and dive is what I'm doing. Take her as deep as possible. So I'll be signing off now since the radio doesn't work underwater . . ." The voice thinned and died and the microphone fell from Gus's hand with a clatter. Far out to sea there was a flurry of white as the sub went under. Then the ocean was empty.

"Call him on the sonarphone," said Gus.

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"I've tried, sir, no answer. I don't think he has it turned on."

Silence then, absolute silence, for the word had been passed as to what was transpiring and everyone there now knew what was happening, what one man was doing for them. They watched, looking out to sea, squinting into the sun where the submarine had gone down, waiting for the final act of this drama of life and death being enacted before their eyes, not knowing what to expect, but knowing, feeling, that although this atomic energy was beyond their comprehension, its manifestations would be understandable.

It happened. Far out to sea there was a sudden broiling and seething and the ocean itself rose up in a hump as though some ancient and evil denizen of the deeps was struggling to the surface, or perhaps a new island coming into being. Then, as this evil boil upon the ocean's surface continued to grow, a fearful shock was felt that hurled men from their feet and set the cranes swinging and brought a terrible clangor from the stacked sheets of steel. While all the time, higher and higher the waters climbed until the churning mass stood hundreds of feet in the air and then, before it could fall back, from the very center there rose a white column, a fiercely coiling presence that pushed up incredibly until it was as high as the great peak on the nearby island of Pico. Here it blossomed out obscenely, opening like a hellish flower until a white cloud shot through with red lightning sat on top of the spire that had produced it. There it stood, repellent in its concept, strangely beautiful in its strangeness, a looming mushroom in the sky, a poisonous mushroom that fed on death and was death.

On shore the watchers could not take their eyes from the awful thing, were scarcely aware of the men beside them, yet, one by one, they removed their hats and held them to their chests in memory of a brave man who had just died.

"There will be no more work today," said Gus, his voice sudden in the silence. "Make the announcement and then you all may leave."

Out to sea the wind was already thinning and dispersing the cloud and driving it away from them. Gus spared it only one look then jammed on his topee and left. Of their own accord his feet found the familiar route to the street and thence to El Tampico. The waiter rushed for his wine, brought it with ready questions as to the strange thing they had all seen, but Gus waved away bottle and answer both and ordered whiskey. When it came he drained a large glass at once, then poured a second and gazed into its depths. After a number of minutes he raised his hand to his head in a certain gesture and the guardian form of the great Indian appeared in the doorway behind and approached.

"Nobody here to give the bum's rush to," said Sapper.

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"I know. Here, sit and have a drink."

"Red-eye, good stuff." He drained a tumbler and sighed with satisfaction. "That's what I call real firewater."

"Have some more. In fact you can have the bottle. Stay here and drink for a while—and don't follow me. I'm going inside and out the back way."

The Algonquin puzzled over that for a moment, then his face lit up in a wide grin. "Say, now that's what I call a good idea. Just what an Indian does. Get woman to drown sorrows. I'll tell you best house . . ."

"That's perfectly fine, but I'm old enough to take care of myself. Now just sit here."

Gus fought back a smile as he rose; if only Sapper knew where he was going. Without looking back he went through the dining room and up the stairs that led to the rest rooms. However, after he had entered the dark hallway he stopped and listened to see if he was alone. When he was sure that he had not been followed he went swiftly and quietly to the window at the end of the corridor and pulled it open; it was unlocked and well greased and opened silently. In one swift motion he was through it and balanced on the ledge outside, closing it behind him before he dropped into the dark alleyway beyond. He had not been seen; blank, cracked walls faced him and noisome refuse barrels stood close by. There were people passing at the sunlit end of the alley, none looking in, yet to be completely sure he waited until the street there was empty. Only then did he run silently across to the other building, to the door recessed there that opened as he approached and closed behind him.

"It went all right? You weren't seen?" Tracy asked.

"Fine, just fine. Sapper is guarding my flank."

The Pinkerton man nodded and led the way to another room, well lit by electric bulbs since the shutters were closed and the curtains drawn. There was a radio set upon a table here and a man sitting before it who turned and rose as Gus entered.

"Sure and I feel like a departed spirit," O'Toole said.

"You did an excellent job."

"It's the actor in me, sir, and you were no slouch yourself. Why for a while there I was convinced that I was really back on the old *Naut* and sailing her out for a deep six and it fair to choked me up. She was a good ship and 'tis a pity she had to go like that."

"A noble end, and far better than the breaker's yard where she was headed. Her glands were beginning to leak and fissures develop in her pressure hull. This way her destruction served a good purpose."

"Yes, I'm sure you're right, though I have to mind the danger from all that radiation that the technical manuals warn us about."

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"There is no worry there. The meteorologists assure us that the prevailing winds will carry the radiation out to sea away from the shipping lanes, and that the radioactive materials in the sea water will be dispersed and harmless."

"An encouraging thought. So with that taken care of the next order of business will the the grand adventure you are embarking on this evening—that will give some meaning to the demise of the dear old *Naut.* Can I go with you?"

"No!" said Tracy in a commanding voice, his fingers lingering near the butt of a revolver that had been pushed into the front of his belt and concealed by his jacket. Another man, who had been sitting quietly in a chair in the corner rose swiftly and it could now be seen that a gun had been in his hand all of the time. Tracy waved him back. "At ease, Pickering, he won't be coming with us. Captain Washington, when I gave permission for another man to be informed of events it was with the firm understanding that he would remain in this room until circumstances had run their course."

"And so he will, Tracy, I gave you my word." He turned back to the submarine pilot who was looking on with a fair degree of incomprehension. "It has to be that way, O'Toole. You have come into this matter blind, just taking my word that sabotaging your own sub and sending her out to sea to blow up and pretending, by radio, that you were aboard her, was important—and highly secret. Perhaps you have some hint of what is involved, but I ask you to keep it to yourself if you do. And remain in this room with Pickering, for your own good if for no other reason. We are up against desperate men and we must needs be as desperate ourselves and it is my firm belief that either of these two men would shoot you dead rather than permit you to leave this room this evening."

Both of the secret operatives nodded silent agreement while O'Toole shrugged in submission. "So be it, sir. Since I've committed suicide once today I'll not be wanting to do it twice."

"Sit under this light," Tracy told Gus, the matter ended and the revolver buttoned from sight again. "No one must recognize you or the game is up."

Under his skillful fingers Washington changed into someone else, so abruptly and efficiently that O'Toole breathed the names of a saint or two as he watched the transfiguration. First brown dye, rubbed well into his hands and face, then pads were slipped inside his cheeks, some brisk work with a dark pencil to accent lines in his skin, invisible rings put into his nostrils to widen and round them, all of this climaxed by a thick moustache attached with spirit gum with a wig to match. When Gus looked into the mirror he gasped, for a stranger looked back at him, a

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Latin gentleman, one of the islanders perhaps, bearing no resemblance to the man who had sat first in the chair. While he admired this handiwork Tracy was busy on his own face, working the same sort of transformation, climaxing the entire operation by producing two pin-striped suits with wide lapels and stuffed shoulders, definitely of a continental cut, as well as black, pointed shoes. After they had changed into the clothes O'Toole let a thin whistle escape through his teeth.

"Why sure and I could pass you in the street and never know, and that's the truth."

"We must leave now," Tracy said, looking at his watch, calmly accepting the praise as his professional due. "We must use a roundabout route to reach the meeting place."

Darkness had fallen while they prepared their disguises so that the side streets and alleys that Tracy preferred were blacker than pitch. But he seemed to have acquainted himself with the underworld geography of the city for he made his way unerringly to their goal. As they paused, outside a darkened doorway no different from a hundred others they had passed, he bent close and whispered.

"These are bloodthirsty men and sure to be armed. I have a second revolver if you wish."

"No thank you. I am a man of peace, not war, and abominate the things."

"A necessary tool, no more. But I have heard that your right cross was much respected in college boxing and more than once you were urged to enter the professional ring. If it comes to close work there is nothing wrong with fists."

"I agree and look forward to the opportunity with pleasure. Now—lead on."

The door proved to be the back entrance to one of the fouler drinking dens that lined the waterfront, though it did have a balcony overlooking the main room where the gentry, or those who passed for it, could drink in a measure of solitude while watching the steaming stew of life below. They took a table at the rail and Tracy waved back two dark-eyed and rouged women who began to sidle towards them. The waiter brought a bottle of the best the house offered, a thin and acid champagne at a startlingly high price, and they touched it to their lips without drinking. Speaking around his glass, in a voice that only Gus could hear, Tracy said, "He is there, the table by the door, the man who is drinking alone. Do not turn to look at him for there are other watchers here besides us."

Casually lighting a thin and dangerous-looking black cheroot that Tracy handed him, Gus threw the match onto the soiled floor and looked offhandedly down at the crowd. Drinking, shouting, gambling, swearing, it was a noisy bustle of life, a mixture of local toughs,

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navvies, coarse seamen, a den of a place. Gus let his eyes move over the man at the table just as they had moved over the others, an ugly man with a perpetual scowl, the agent Tracy had referred to as Billygoat. He was garbed as were the other navvies, for he had been working on the tunnel, at the waterfront section. He could have had access to the submarine which had first originated the idea in Gus's mind. His sabotage theoretically successfully finished, he was waiting for his pay-off, waiting to meet others in the sabotage gang since now, by his drastic act, he had proven his worth.

It was then that, out of the welter of voices below, Gus made out one that sounded familiar, a bull-like roar that he was sure he had heard before many a time. He allowed his eyes to roam across the crowd again and controlled himself so he gave no physical sign of what he saw, but instead finished his slow survey and raised his glass. Only when the glass was before his face did he speak.

"There's a navvy down there, Fighting Jack, my head ganger from the English end of the tunnel. If he recognizes me—"

"Pray he does not for we are lost then and the entire operation must be scrapped. I know he arrived today with a levy of men for the English tunnel, but why of all the odds did he have to pick this establishment out of the many of its type to do his drinking? It is just bad luck."

And there was worse luck to come, as a hoarse bellowing in the street outside indicated. The door crashed open and through it came Sapper Cornplanter, more than three sheets in the wind, the full bottle Washington had ordered earlier that evening now almost empty in his hand. If anyone there had managed to miss his noisy arrival, he informed them now with a warbling war cry that set the glasses dancing on the bar.

"I can lick any man in the house! I can lick any three men if no one man has guts to stand up! I can lick any six men if no—"

"That is a heap big Indian bag of wind."

As these words were uttered Sapper froze and his eyes narrowed as he slowly turned his head in the direction of the speaker moving with the deadliness of a swiveling gun turret, his eyes as menacing as twin cannon. As he did this Fighting Jack climbed to his feet. In the balcony above Gus stifled a groan as Sapper answered.

"And you are a limey liar."

As he spoke the words he seemed completely sober, while at the same time he cracked the bottle against the door frame so that the jagged neck remained in his hand. Fighting Jack kicked his chair aside and stepped clear.

"Need a broken bottle, don't you, Indian? Can't face up t'a white man's fists." He disclosed just what one of these objects would look like by lifting up a clenched hand the size of a small spade. There was a crash as

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Sapper discarded the bottle and moved forward.

"Any white man can use his fists—but can one of them *Indian wrestle?"* The answer came in a roar.

"I can do anything you can do—but better!"

They stomped towards each other, feet shaking the building, while the men in between them fled. Not until they were standing face to face did they stop, noses touching, eyes glaring, teeth bared, like two bison muzzle to muzzle, or a pair of great locomotives neither of which would give way. With unspoken agreement they stepped sideways and sat at a recently emptied table, swept the glasses and bottles to the floor and hurled their coats from them, rolled up their sleeves and thudded their right elbows onto the scarred wood as they seated themselves. Their gazes locked as their hands met and grasped and squeezed, tight, each clenched tightly enough to crush solid wood but not tight enough to do any damage to the opposed member. With their grips strongly engaged each man now exerted himself to push the other's hand back to the table so the knuckles touched, thereby winning. A simple enough procedure, easily and quickly resolved in most instances, as the stronger or more resolute man vanquished the other.

Not this time however. If ever two giants were equally matched these two were—and neither would give a fraction of an inch. The muscles in their arms stood out like gnarled steel and the tendons were bar-hard as every iota of strength they possessed went into the struggle. They were well matched however, even too perfectly matched, for neither could gain an advantage, strain as he might. The crowd watched this battle of the titans with bulge-eyed attention, so silent with awe that when the muscles in Fighting Jack's upper arm split through his shirt the rip of the cloth could be clearly heard. A moment later the shirt across Sapper's brawny shoulders parted in the same manner from the strain. And still they fought on, locked in a rigid and deadly embrace: neither would give in, neither would relinguish victory.

There was a sharp crack as the top of the table split in two under their steady pressure and fell away. Now that their elbows were no longer supported they rose slowly to their feet, still locked equally, still straining with such force that it seemed human flesh and bone could not stand against it.

A whisper of awe sussurated through the room for it was scarcely believable, this sight which they were seeing with their own eyes. The hum and buzz of voices grew louder and there were a few cheers, including a war whoop from a table full of Onandagas. In response one of the English navvies shouted out "Break him in half, Fighting Jack!" and there were other calls as well. Strangely enough all of this had an odd effect on Sapper who, without

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relinquishing his hold in the slightest, looked up at his opponent and spoke, with some difficulty so tightly cramped was his jaw.

"Are you . . . the head ganger . . . Fighting Jack?"

Fighting Jack had the same difficulty in speaking but managed to produce the words, "I am."

The results of this simple statement were startling to say the least, for when he heard them Sapper ceased straining against the other's arm. Taken by surprise Fighting Jack was off balance and fell sideways and was twisted around so that the Iroquois was able to slap him on the shoulder as he went by. The result was what might be expected for the English ganger did not take lightly to this kind of treatment, so he continued turning until he had swung about in a full circle and was facing his opponent again—this time with his fists clenched and ready to do havoc. But before he could spring to the attack the Indian spoke.

"Well I'm the head ganger name of Sapper Cornplanter."

Fighting Jack's fists fell and he straightened up, evidencing the same look of surprise that had been on the other's face a few moments earlier. They faced each other like this, then began to smile and in a moment began to laugh, shaking and bellowing with laughter to the bemusement and befuddlement of the onlookers, who were even more greatly shocked when the massive navvies clapped arms about each other's shoulders, seized up bottles from the nearest tables and went out of the door laughing and drinking together.

"I presume you could explain their actions," the Pinkerton man said.

"Surely," was Gus's response. "You know that Sapper is my head ganger here, and that Fighting Jack was my head ganger on the English end of the tunnel. Each man has heard of the other, knows of him by reputation, and knows as well that they are both my close friends, which to a navvy makes them butties as well. So you see they have no reason to fight but instead plenty of reason to drink together which I am sure they are doing now."

As he finished speaking Gus looked back to the table where the agent, Billygoat was sitting, whom he had forgotten for the moment, and he fought hard to conceal the shock that overwhelmed him.

"He's gone! While we were watching the others, gone!"

Their mission was compromised; through inattention they had missed their chance to capture their saboteurs. Gus was abashed by this knowledge but Tracy seemed coldly indifferent. He had his watch out, a large pocket turnip, and was looking at the face of it.

"While *you* were watching the others," said he, coolly. "I am too much an old hand at these matters to be distracted that easily. During the excitement the contact man saw his op-

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portunity and signaled to Billygoat and they have both gone."

"You should have told me, now we will never find them."

"Quite the contrary; everything is going according to plan. I informed you that there were enemy watchers here and if we had left right after the others it would have been noticed and there would have been trouble. As it is we can now pay for the slops we drank," he threw some coins on the table as he said this, "and leave now that the excitement is over. We will not be followed." He glanced at his watch again before putting it away and climbing to his feet.

Gus came after, amazed at the other's calmness in the face of obvious disaster, following him down the dank passage and out into the street once again. They gained the main avenue and Tracy turned in the direction of the waterfront.

"I will keep you in the darkness no longer, Washington," said he. "As you have technical secrets in your trade so do we in mine. And Pinkerton has the best. The agent, Billygoat, has a certain device concealed in his right boot, in reality built within the sole of the boot itself and indetectable by any normal search. When contact was made with him he stamped his heel down hard in a precise manner. This ruptured a thin membrane within a cell that permitted acid in one half to flow into the other half, thereby transforming the inactive cell into an operating battery of great strength. The current thus generated goes to a powerful but compact radio generator also in the boot sole, the signal of which is sent up a wire that has been woven into the seam of his trousers. This connects to an aerial within his belt which broadcasts the powerful short-wave signal. You have seen me glancing at my watch?"

"I have indeed, and wondered at your sudden interest in the hour."

"Not the time at all, for this watch contains a compact receiver, a direction finder that is tuned to the radio signal from Billygoat. See for yourself."

He extracted the watch and held it flat in his hand, there being enough light from the nearest street gas lamp to make out the face. When he pressed the crown the hour hand glowed softly and spun about to point down the street towards the sea; then it returned to its proper position indicating the correct time when he released his grip.

"Ingenious, wouldn't you agree? They are ahead of us, so let us proceed. We cannot see them which is perfect, for that means they cannot see us and will be unalarmed. The radio will point the way."

As long as the street was well lit and occupied they strolled along casually, just part of the throng. But when the avenue they were on ended at the unlighted docks they turned around, as though completing a stroll there, and went back the way they had come. At the first turning

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they stopped for a moment and talked, still the casual strollers, while Tracy made sure they were not being observed. When they were clear he stepped into the shadows of the crossway and drew Gus after him.

"They are on the waterfront somewhere, the finder pointed in that direction. We shall make our way parallel to the harbor until we have a better indication of their destination."

They did this, stumbling over rubbish and litter and disturbing cats and rats in their nocturnal rounds, until Tracy halted once again at a crossing and studied the pointing hand.

"Most interesting, for it now points slightly back in the direction from whence we came. Washington, you are the engineer and the surveyor and have an eye for this sort of thing. Take a bearing here down the street and we shall go back a bit to the next street for another cross bearing. Can you do that, determine where they are?"

"That is my trade," he said with some assurance, squinting along the tiny arrow.

When he had repeated this ritual he thought for a moment then led the Pinkerton agent forward to a spot where they could see the dark wharves and the ships beyond. Unhesitatingly he pointed his finger.

"They are there."

"Aboard that ship? You are sure?"

"You said earlier that you could not be distracted from your job. I might say the same for mine."

"Then I unhesitatingly accept your information. We are ready for the final act to begin."

Tracy then moved back a few yards in the direction they had come from and raised a whistle to his lips and blew lustily into it. Gus was slightly startled when no sound, other than the slight hiss of escaping air, emerged from it. Tracy saw his expression of puzzlement and smiled.

"Supersonic sound, that is sound waves that are too high-pitched for the human ear to hear, but these sounds were not meant for the human ear as you can see."

Two men appeared, the first of them leading a small dog on a leash. Tracy bent to pet the beast and explained. "Trained to come to that sound. These are my men who have been keeping watch over us waiting for my signal."

"I had no idea they were there."

"They are professionals."

Tracy issued swift orders, then he and Gus went forward once again. "My operators will surround the area and close in, but I must lead the attack. You need not come with me—"

"I am your man."

"Good. I was hoping you would. I want you there when the curtain falls on the last act of this little drama."

Tracy went first, silent as a cat, with Gus a few yards behind. They stayed close to the walls, in the darkness, and worked their way to the

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spot nearest the ship, where a single tiny lamp on deck cast a weak glow on the battered gangway. Tracy halted for a moment, looking at the ship, and when he did a shadow detached itself from the wall behind him and lurched forward.

Gus had only a split second to act in, and he did not want to call out a warning, so he jumped forward as well. His fist came up in a short, wicked arc that ended on the mysterious assailant's jaw with a sharp crack that caused Tracy to spin about. There was a small thud as the club the man had been wielding fell to the cobbles, then Tracy was helping Gus lower the unconscious man to the ground as well.

"I am glad you are here, Washington," said he, and from a man of his professional caliber this was reward enough. "That was a blow well struck and my men will have him before he regains consciousness. They will be closing in now to cut off all means of escape by the criminals, while fast launches will prevent flight by sea. The final act of this drama is about to be played. You were correct in your deductions, for I have checked my direction finder. Billygoat is aboard that ship. Now here we go."

Silent as a wraith he drifted forward, with Gus a few paces behind. They passed under the counter of the ship and her name could now be seen, picked out in rusty letters across the stern. *Der Liebestodt, Lucerne.* Swiss registry, a flag of convenience obviously, with the real names and nationality of the true owners well concealed. But not much longer. All was silent on the deck above, the ship darkened except for that single bulb at the entranceway. Tracy walked forward steadily as though he belonged here and mounted the gangway, with Gus not too far behind. Yet, quiet as he was, he was not unobserved, for when he reached the deck a man stepped out of the shadows and mumbled something inaudible to Gus who was still on his way up. Tracy answered and pointed down and, as soon as the man had turned, the operative's hands struck and did something to the other's neck that kept him rigid for long moments before he folded and fell to the deck.

There was still no alarm, and Gus could not believe it. They had boarded the ship, rendered two men unconscious, and their presence was still unknown. Their luck seemed too good to last and he hoped that would not prove the case. Tracy waited in the open doorway until he came up, then whispered into his ear.

"The deckhouse is quiet and there is no one on the bridge—so the miscreants must be below. Follow me as silently as you are able."

With these words he pushed open the heavy iron door to disclose a dimly lit passageway beyond, into which he drifted. The first door off the passage was dark and he passed this opening with only a quick look,

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and the next, dark and open as well. But the one that followed was closed and he bent to peer through the keyhole, then took a doctor's stethoscope from his pocket and listened at the door panel with it. Satisfied, he restored it to his pocket and waved Gus on, pointing to the stairwell at the same time. Down this they went, slowly and carefully, and their reward was immediate for one of the doors on this deck stood partly open and from it emerged a bar of light and a mutter of voices. Still leading, Tracy went forward, past another darkened doorway, with Gus close behind. As Gus passed the same doorway a dark figure, knife clutched in hand, leaped to the attack.

Only split-second reflexes saved his life. Gus fell back as the man hit him, falling under the swooping slice of the weapon, clutching at the knife arm, and rolling away with his assailant on top of him. There was a hearty thud as they fetched up against the bulkhead opposite, the force of the impact stunning the man for an instant, the force of Gus's fist stunning him more lastingly so that he sighed and went limp and the knife fell from his hand and rang loudly on the metal deck.

In the silence that followed the voice could be clearly heard through the open door.

"What was that? I heard something in the passageway."

Tracy stayed himself no longer. His revolver appeared in his hand and, as he kicked the door wide, he shouted defiantly, "This is the law and you are all under arrest!" then sprang into the room.

There were shouts, shots, muffled screams as Gus plunged forward, hurling himself without hesitation into the unknown fray, into a large cabin seemingly filled with rushing men. One of them tried to escape but Gus was in his path and a hard fist in his middle bent him double, lowering his chin to the correct spot to connect with the other fist on its way up. Gus plunged on into the mêlée and raised his arm to prevent a blade from descending that was slashing at his throat and a red arrow of pain shot through his biceps as the blade cut deep. But he still had a good arm that ended in an equally good fist that dropped the attacker on the spot.

With that the battle was over although Gus did not know it as he struggled to his feet, ignoring the pain of his wound. Disreputable men damaged in various ways lay sprawled about the room while Billygoat sat astride the single conscious survivor banging his head against the deck so that he could join his comrades in unconsciousness. Tracy moved quickly about putting handcuffs on any that showed signs of life while Billygoat ceased his banging and rose, dusting off his hands and pointing at a closed door on the far side of the cabin.

"He went through there during the

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fracas. The Gray Man, the one in charge."

Tracy took in the situation in an instant and kicked a wicked looking automatic pistol across to Billygoat who swooped it up.

"Guard the prisoners then because I want as many as possible alive."

Even as he spoke he was hurtling across the room to smash his shoulder into the flimsy connecting door, bursting through it with Gus, who had tied his kerchief about his wounded arm, right behind, straightening up and raising his gun and saying, "You will stop right there for the jig is up."

The man he had addressed did stop what he was doing and straighten up slowly with a sheaf of papers in his hand. He had been thrusting these along with others of their kind into a metal wastebasket within which a smoky fire flared. As soon as Gus was aware of this he leaped past the Pinkerton man and kicked the basket over to stomp out the smoldering flames. Only when this task was done did he straighten up and look at the man they had captured, the secret protagonist at last.

He was indeed a gray man as Billygoat had said. He stood erect beside the desk there, one fist pressed to it, the other to his chest, swaying slightly. From toe to top he was gray, clad completely in gray from the gray spats that covered his gray shoes, gray top coat and gray suit, of a good cut, gray broadcloth shirt with matching gray tie, a gray fedora upon his head and a mask of gray cloth that concealed his face except for the pair of holes cut in the fabric through which peered a pair of gray eyes.

"Do not make a move," Tracy ordered as the man's hand moved towards the desk. The gray man jerked back his hand and responded in a strained whisper.

"There is money in the drawer here, much money to pay those outside. It is all yours, thousands of pounds. All you must do is turn your back for a few moments, that is all I beg of you. Let me leave—"

"You take me for a fool, sir! I am of the Pinkerton's and in the employ of The Transatlantic Tunnel Company, and there is no bribe in the world big enough to tempt me to compromise my honor. You are taken and that is the end of it. The game is up."

At this the gray man crumpled, in such a tragic manner that Gus was tempted to go to his aid. All semblance of power was gone now and the figure trembled, groping behind for a chair to drop into. The professional Pinkerton operator was as unaffected as Gus was touched, for he had apprehended many a hardened criminal before, so that when he spoke it was harshly.

"Now sir, you will remove that mask—or shall we do it for you?"

"No . . . please, no . . ." was the gasped answer, but it touched Tracy not. Gun held at the ready he

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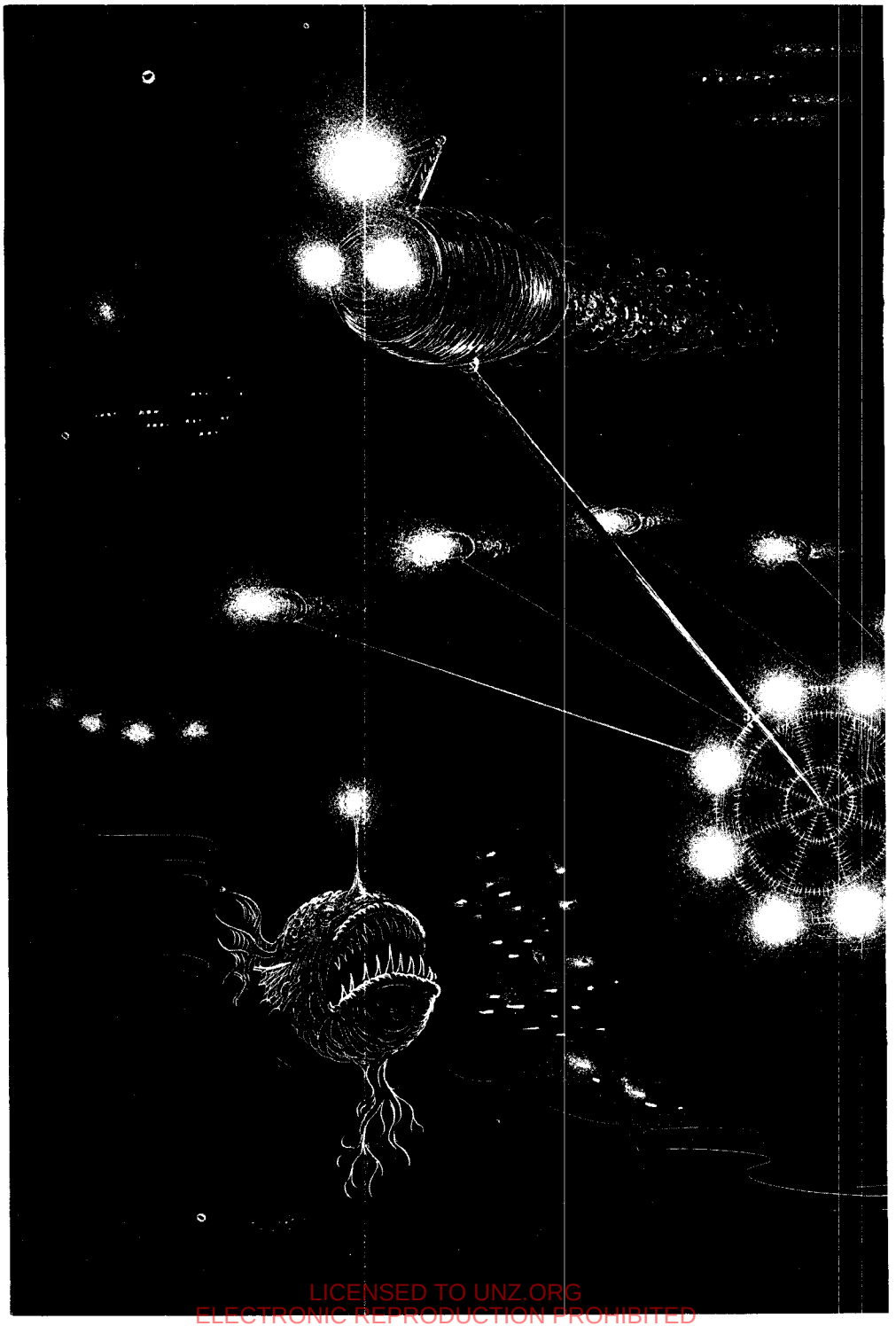

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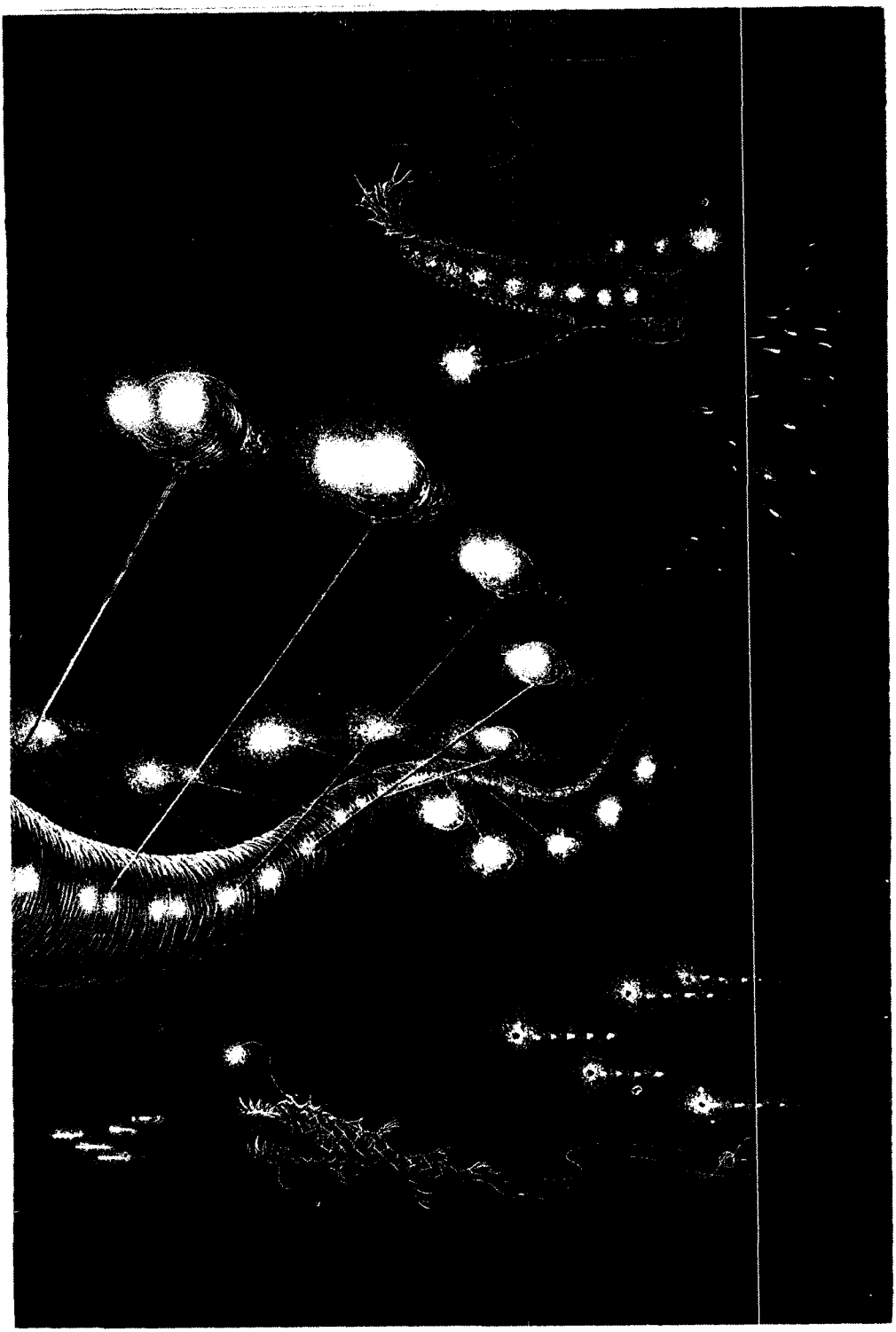

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stepped forward, seized mask and hat in one hand and, with a single gesture, hurled them aside. Gus gasped.

Sitting there, the mask removed, was someone he knew, someone he would never have suspected, someone who could not possibly be in this place at this time.

"Do you know who that is?" asked Gus.

"A hardened criminal," Tracy responded.

"No, it can't be, he is not. But still he is here. It is unbelievable."

"You know him then?"

"Of course I do! That is none other than Henry Stratton, a respected financier from Boston and a member of the New York branch of The Transatlantic Tunnel Board of Directors."

"Well then, it seems we have our man at last. A member of the Board of Directors indeed! It is no wonder the criminals were privy to all your secrets and could strike wherever they wished."

While they spoke Stratton sat with lowered eyes, limp with exhaustion and defeat, uncaring. However when they had finished he struggled himself erect and a little of his old fire returned to his voice that no longer whispered.

"I beg of you gentlemen to release me. The disgrace, my family, you cannot understand. If I am released I promise—"

"No," said Tracy and in his voice was the immutability of doom, the monolithic force of destiny, so powerful that Stratton wilted again under the irresistible assault.

"Yes, you are right, I should not ask, a last desperate attempt of a desperate man. I am doomed and have been so since the beginning had I but the wit to realize it."

"But why?" Gus burst out. "What could lead you, a respected member of the community, to such reprehensible actions?"

Stratton looked up at him slowly, then smiled a wintry smile that held no slightest touch of humor.

"Why? I might have expected you to ask that kind of question, Washington, since you are the sort that is never bothered by the kind of human problems that trouble others. You are a machine for building tunnels, that is what you are, and do not suffer from the frailties of we mortals. You ask why? I will tell you and it is a sordid story indeed, a progress into hell that began with but one false step.

"I am a member of the Board and have invested my all in the company. But I was greedy and wished more, so secretly sold some stock from an estate for which I am executor to buy more tunnel stock, meaning to return the money as soon as the first dividends were paid. But these were stocks in a certain shipping company, for mine is a family with old shipping interests, and I never knew that I was being closely watched. I was approached by—shall we say,

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parties in the shipping business—who knew everything I had done. They promised to help me, and they did, so my thefts would not be discovered, and I had but to render them certain small services in return. I did these things, acting as a spy within the Board for them, passing on information until I was too compromised to back out. Then they pressed for more and more services until I ended up where you see me now; on the one hand a respected member of the Board, while on the other I direct the secret agency that is doing its best to destroy the tunnel. Gad! I am glad it is at an end at last."

"Who are these people who have done this to you," asked Gus.

Stratton waved a weary hand in the direction of the papers scattered about the cabin.

"It is all there, you will find out for yourself soon enough. Shipping interests, foreign countries, all the men of power and men of evil who felt that the tunnel would do them no good, the countries who wish England and the Empire ill will at all times. A consortium of crime such as has never been seen before. It is all there, my correspondence, carbon copies, notes, directives, every bit of it for I am a thoroughly organized and efficient New England businessman and whatever business I transact, no matter how low, it is done in a meticulous manner. All you need is here. With it you will be able to destroy the ring and the saboteurs forever, you have my word on that. It will all come out, I can see that now, and my good name will be ruined forever. Therefore, I ask you but one favor. Gather up the papers and quit this room for a few minutes. I will not be long. There is only the single tiny porthole so you know I cannot escape in that manner. Please, I beg of you, as men of honor."

"No," said Tracy, firmly, "for you are our best witness."

"Yes," said Washington with the voice of command. "We have prisoners enough outside, if it is prisoners that you are interested in. What I care about is stopping the sabotage and exposing the fiends who are behind it—and we have them here in these papers. Look at these names! Respected men, powerful companies! There will be arrests and some sliding stocks in the market and the sabotage will end once and for all. The foreign governments can't be touched, but their active interests can be exposed and that will keep them in line for a good while. We have what we need here. I insist that we grant Mr. Stratton's request."

Tracy hesitated a moment, then shrugged. "Justice will be served and my fee will be just the same. If you insist—and take full responsibility for the decision."

"I do. And I know Sir Winthrop will back me up."

As they gathered up the papers and prepared to leave the voice of the ruined man hissed after them. "I hate you, Washington, you and all the things you stand for. But, for my

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family's sake, I begrudgingly offer thanks."

Soon after the door was closed behind them a single shot broke the stillness and after that all was silent again.

XI

Here, two miles beneath the surface of the Atlantic, was the realm of eternal night; dark, silent, and still, an empty world of black water. The surface of the ocean with its winds and weather, breaking waves, surging currents and burgeoning life was more than ten thousand feet above. That is where the sunlight was and the plankton, the microscopic life forms that cannot live without it, and the small fish that graze upon these seagoing meadows, and the larger fish that feed upon them in turn. Up there was the sun with its energy and the oxygen that made life possible in the ocean depths, and just as the depth increases so does the quantity of life decrease until, a mile down, the tiny piscine monsters who dwell at this dark level are few and far between. Strange creatures of needle teeth and bulging eyes, with rows of lights like portholes down their sides or hanging out in front, tiny mites of ferocity like *Chiasmodon niger,* just two inches long but so voracious it swallows fish bigger than itself. But this was the last battleground, for below there was little life and less motion, until the bottom was reached at a depth of three miles where a great current flows in the direction opposite to the Canary Current on the surface above. But here it was black, empty, lifeless, still, unchanging.

Yet, can it be, is that *something* approaching far in the distance? Lights, yes indeed lights, pinpoints of brightness in the endless night, moving steadily along. A school of fish perhaps, for the lights grow more and more numerous until they stretch away and dim out of sight. Wait, there seem to be two different species here, smaller fish, though small only in comparison for they are as big as blue whales, surrounding an immense sea snake that undulates through the water with serpentine skill, a snake with its own rows of lights down its sides that go on and on, an incredible creature that is over a mile in length. But what is this? The snake is held captive by the smaller fish, linked to them with strong bonds, pulled along by them. What manner of creatures are these with hard, smooth skins, eyeless yet with burning lights, humming and thrashing loudly as they disturb the stillness of the deeps? No living beast at all, but metal shells containing the only living creature that dares to enter this lifeless realm, man, the most daring animal of all.

Ahead of all the other submarines was the *Nautilus II,* far mightier and more complex than her atomized namesake, with a crew of thirty needed to manage all the machines and devices she contained. Few of

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them were needed to control the submarine, for she was as simple to operate as her predecessor, but were there instead to manipulate the ancillary apparatus. Steel cables ran from reels set into her keel, stretching out to the front of the mile-long tow, controlled by automatic devices that monitored these cables constantly, keeping them at a certain tension, letting out a length of cable when the pressure rose too high, reeling in some when it dropped.

The information about the tension on the cables was fed along electric wires to an enormous Brabbage computer engine that took up almost a quarter of the space in the submarine, that received information from the cables of every other one of the submarines as well, monitoring them all, adjusting tension and pull so they moved as one with their immense burden. No material wires connected the engine to the other submarines; communication was carried on by immaterial wires of another sort—beams of light, coherent light from the numerous lasers that studded the hulls. These laser beams penetrated the water with ease and their energies were modulated to carry the needed information. All went well, all worked well, a tribute to the innate ingenuity of man that had conceived this project in the first place, of which this was the final section.

From New York City the train tracks now sped, to dive under the waters and rush across the ocean floor in the newly manufactured tunnel there to enter the fracture zone that split the ocean bed, to rise up through this into the mountains of the Mid-Atlantic Ridge where they ended at the very tip of the canyon that bisected this ridge. On the far side of the Atlantic a similar length of track left London and entered the tunnel there and moved out to the Azores, to lift up briefly before diving again to the abyssal plain, reaching next the fracture zone and the opposite edge of the canyon. There the two tunnels ended, their blank ends facing one another across a mile of empty water at the very edge of the Rift Valley depths that plunged far out of sight below.

Here now, at last, swimming slowly to its destiny, came the incredible sea snake of the mile-long tunnel that was both tunnel and bridge, an upside-down bridge that floated, that would pull *up* against its supports instead of hanging down, a steel and concrete, cunningly contrived bridge-tunnel that did indeed undulate like a snake as it swam along. The secret of its motion was the joints between sections, bellows-like constructions of solid steel, steel strong enough to resist the great pressures of the deeps, yet flexible enough to bend as needed. This was the mighty construction that would finish the Herculean labor at last, this was the final link in the tunnel between the continents.

It had been two long years in the

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building, the sections constructed at different sites and floated to the rendezvous up the Hudson River, below the ruined fortress of West Point, long associated with the heroic General Benedict Arnold. Here a new form of warfare was engaged; man against the elements, battling to conquer the endless sea. Section by section the bridge-tunnel had been joined together and tested until the incredible structure was completed. Then, on the ebb of the tide, it had been submerged and floated down to the sea, the beginning of the journey that was now reaching its final stages.

On the bridge O'Toole sat at the controls, or rather watched the controls because the computer set the course for this submarine as well.

"There are some things that take a bit of getting used to," said he, arms folded so his fingers wouldn't twitch towards the levers and buttons, eyeing the compass suspiciously as it swung a bit then steadied. "Now I know in theory that we are homing in on the sonar beacon at the bridge site, and that the infernal machine back in the bilges is pointing us all that way and running the engines and the rest, now I *know* that, but sure and I do not *believe* it."

"I think you do," Gus said, smiling as he bent over the plotting table and noted their slow but steady progress across the map. "All you want is a little action, a fist fight or a few drinks, or something like that."

"How you blacken the name of O'Toole!" he cried, with no sincerity at all, but with a matching smile as well. "Though truth be known a jar of Guinness would not be refused, I'm thinking."

A light glowed redly on the board and his fingers rushed to the controls and made certain adjustments. "Proximity to beacon ten miles, dead ahead."

"Time to begin cutting our speed. We want to be at almost zero forward motion when we reach the canyon so we can use our maneuverability against the current." He called down to the computer section and issued the needed commands.

Slower and slower the great snake drifted, taking many miles to slow down so great was its mass. The sonar beacons, strategically placed below, guided it to the correct spot where all forward motion ceased, where the final drop could begin. One mile straight down, out of the still waters into the bottom current which, slow moving as it was, still exerted a powerful force on anything as massive as this bridge-tunnel. The flow of the current had been carefully measured and this was one of the factors that was also taken into consideration by the computer so that when the bridge began the drop of the last mile it was still some miles upstream from the tunnel site. As the giant construction fell at a regular rate it would be carried along at a certain speed as well, theoretically to end up at the correct spot at the correct depth.

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The last fall began. Delicate pressure mechanisms in each tunnel section admitted sea water to the ballast tanks as they drifted downwards so that while the pressure increased the tunnel always had the same slight positive buoyancy. Down and down and down—until at last ruddy lights were visible below and the computer had the laser beams as more definite navigation points. It digested this new information instantly and some of the submarines went faster while others slowed so the bridge bent and straightened again as it was turned slightly and aligned with the still invisible piers in the depths.

"There they are," Gus said, pointing at the lights now visible on the television screen of the darkened bridge, television because the egg-shaped, thick-walled submarines that operated at these depths dared not have openings or ports of any kind in their hulls, so that all outside viewing was done by electronic means, with pickups at bow and stern, topside and in the keel. It was the keel pickup that now revealed the lights below and ahead of them. "We are on course to five decimal places," said he, looking at the readout from the computer beside him.

Now the final, most delicate and most dangerous part of the mission was about to begin. The current here flowed steadily and smoothly at a speed of almost one and a half knots, hardly anything to speak of; if it had been on the surface a good swimmer could have breasted it, a rowing boat made progress in it, a fast launch ignored it. Even below the sea the submarines paid the current scarcely any heed—when they were on their own. But now, with their massive tow, it became their primary consideration, for the thirty-foot thick and mile-long bridge had an immense surface area that the current pushed against, so strongly that it was doubtful if the united force of all the submarines could have held it steady much less gained against its pull. Therefore the attempt to put the bridge sections into place must be right the very first time.

In order to accomplish this the cables had to be secured on each side of the valley at the same time and locked into place. The towing lines from the submarines were fastened to the much more massive cables of the bridge, each over a yard in diameter, for these served a dual function, now being used for towing, but upon arrival they would become the permanent mooring cables that held the bridge in the correct position. The ones from the center section were the longest—well over a half mile in length because they had to connect to the buttresses at each end—while the others grew shorter and shorter the closer they came to the end. When in position this skein of steel cable would hold the bridge inflexibly in place as its buoyancy pulled them taut. Now it was a matter of securing them.

Below the lip of each edge of the

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canyon there was a great area of smoothed rock that was illuminated brilliantly by numerous lights, for what had to be done next had to be done by eye, the human eye, and no automatic machines could be of aid here. Massive, monstrous anchors had been drilled and cemented into the solid stone to hold the bridge in place, while secured to them were hulking fittings to which would eventually be attached the giant turnbuckles that would be used to tension the cables correctly. But that would come later, now the cables had to be secured quickly and easily. In order to do this, massive, spring-loaded, forged steel jaws projected from each anchor. When a cable was pressed across one of these sets of jaws they would be sprung like a titanic rattrap and would snap shut instantly, their corrugated jaws latching fast while automatic electric motors tightened them even more. This was the plan and it had been tested many times in training and it should work. It *must* work!

Down, down, down, the massive construction fell, with its attentive tugs laboring hard, now pulling this way, now that, under the continuous instruction of the Brabbage engine. There was almost complete silence inside the submarines, aside from the whisper from the ventilation louvers and the distant hum of the engines, an occasional word spoken between the operators of the great computer. Despite the silence and the lack of activity the air of tension was so thick inside every one of the subs that there were those who had some difficulty in breathing, for this was it, the irreversible decision, the unchangeable moment.

Down steadily while the brightly lit anchors below grew larger on the screens, the bold red numbers above each of them standing out stark and clear, and down still more with the cliff coming closer and closer. Fists tightened and knuckles whitened as the pilots simply watched their charges control themselves under the tutelage of the computer brain, this waiting and watching infinitely more trying than any complex control effort would have been. Down. Every detail of the ancient stone and the clean sharpness of the new construction clear before them. Down.

"One and Nine attach, One and Nine attach. You are on your own!"

The voice spoke quickly and clearly over the command circuits, booming from every speaker in every sub. This was the long awaited signal, manual command, the first subs on their way with their cables. Ten cables at each end of the bridge, numbers One and Two being the shortest on top of the pier, Nine and Ten the longest because, from the center of the span, their cables had to reach far down to the bottom of the pier. Now the two subs each with one of the pair of the longest and shortest cables had been released from computer command and were moving ahead on their own to attach

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their cables, racing at full speed to make their hookups. As soon as they had done this the next two subs would be sent in with their cables during the vital two minutes during which the tunnel would be in the right place at the right distance for hookup. Four cables were needed, on each end to anchor the bridge-tunnel against the pressure of the current. If these eight cables were secured the bridge would be held in place; the computations had been exact. Once these eight were in place the remaining mooring cables would be attached one at a time with greater precision. But those four cables had to be fastened first, if they were not there was no telling what disaster might occur as the bridge was swept out of position.

Nautilus II, motors whining at full speed, led the way towards the anchorage, O'Toole busy at last with the controls, yet even as he dived, remembering to ease off on the keel line and tighten up on the bow line that was fastened to the mooring cable like a spring, riding loosely until now. The drum and motor for this line were on a spar that jutted twenty feet from the sub's nose and were easily visible in the forward camera. Well before the sub had reached its goal the heavy mooring cable had been reeled in until it was snug against the end of the spar, the orange painted twenty-foot long section of cable just above it. This was the target area. As long as any portion of this colored area was snagged by the waiting jaws the hookup would be successful, for this area was well within the bending tolerances of the bridge and the natural arc of the cable. For precise measurements a two-foot wide black band was painted about the middle of the orange section, the area of optimum choice.

O'Toole handled the bulky submarine with an artist's touch, spinning it on its beam ends so the spar pointed up and out at the waiting jaws, taking up the weight of the cable, being forced astern for a moment, then thrusting out—but not so fast that he rammed the pier. Up slowly, drifting, correcting, forward, the spar like an immense guiding finger reaching out for the target. Gus, standing behind the pilot, unconsciously held his breath as the pier moved closer and closer until it seemed they would ram into it.

"Got it!" O'Toole shouted with joy as the iron jaws, like a great metal alligator, slammed crunching shut on the cable just on the black band, so strongly they could feel the impact within the submarine. "And now clear and we're away."

He pressed the two buttons that sent an electric current through the wires inside the towing lines, a current which exploded the shackles that secured them to the anchoring cables. The smaller lines dropped free and the electric motors whined to run them in as the submarine backed away.

"Number Nine hooked as well,"

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Gus said, looking at the scene from the keel pickup on his monitor screen. "Numbers Two and Ten begin approach," he ordered into the command circuit.

At that precise moment it happened, just then at the worst possible time for the anchoring of the bridge, a moment when success and failure were suspended on a razor edge of seconds. But world time is a measurement on a different scale; rather say that geologic time is indifferent to mankind's brief existence on the outer skin of the globe, experiencing thousands of years, or even hundreds of thousands of years, as the smallest unit. Pressures had been building in the Earth's core as the tidal flow of molten rock pressed up against the solid crust that floated upon it, building pressure slowly but insistently, pressure that had to be relieved for it could not be endured too long. A seam deep in the rocks opened, a great mass shifted, stone grated on stone and the pressures were equalized, the Earth was at rest again. A small thing in geological time, too small to be even measured, or noticed, in comparison to the mighty forces always at work. Yet large enough to wreak havoc to man's work.

Inside the solid Earth there was a deep grumbling as of some immense giant complaining and turning in his sleep, a sound so great it shook the solid stone above and transmitted itself to the water which in turn struck the solid steel fabric of the submarines, jarring them and tossing them about before passing on.

"Earthquake . . ." Gus said, rising from the deck where he had been thrown. "An undersea quake, just now . . ."

He stopped, aghast at what was happening outside, the scene so clearly displayed on the screen. The tremors in the Earth had been passed to the anchored cables which were bending and writhing like things alive, sending traveling shock waves along their length to the lightly anchored bridge above. The bridge and anchoring cables had been designed to absorb shocks and quakes like these, but as a unit, well secured and soundly anchored. Now the two cables were bearing all the strain that twenty had been designed for. It was impossible; it was happening. What damage was being wrought to the bridge! Gus dared not stop to consider, the damage before his eyes was even greater for, harshly burdened and overstrained, the cables were tearing from their fittings.

Terrible to see, impossible to turn away from, the heavy steel and concrete anchors crumbling and shattering, breaking free. Pulling from the moment's paralysis Gus grabbed for the communicator.

"Number Two, draw or release your cable, do you hear me?"

"I can attach, I can—"

The words cut off, never finished as tragedy struck. With the two holding cables torn loose the floating

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bridge above twisted and moved, bent, floating free, dragging on the attached cables. The submarine, Number Two that was about to attach its cable, was simply lashed forward like a child's toy at the end of a string and thrown against the stony wall. It took a fraction of an instant, no more, as the pressure hull cracked and the incredible weight of the water at this depth compressed, destroyed, flattened the vessel in the smallest part of a second, so quickly that her crew must have had no slightest warning of their doom. It fell slowly, a dead weight at the end of the cable.

Gus could spend no time with concern for the dead now, for he must think of the living, the submarines still attached to the bridge and the fate of the bridge itself. For long seconds he forced himself to stand there, to think logically, to consider every factor before going into action, while all of the time the communicator roared with voices, questions, cries of anguish. Reaching a decision he smashed down the command switch and spoke with cold clarity into the microphone.

"Clear all communication circuits, silence, absolute silence, this is Washington speaking and I want silence." And he received it for within seconds the last voice died away and as soon as it had he spoke again. "Come in Section Two commander, give a report. We have had a quake at this end and are not connected. What is your condition." The response was immediate.

"Section Two commander here. All in the green. Four cables connected, about to go for the next two. Some tremors and movement apparent on our lines."

"Connect next two then suspend operations. Hold at your end for future orders. Attention all Section One subs. We have broken free here and cannot reconnect until bridge is in correct mode. Orders for all odd number subs: All odd number subs, activate your disconnect charges from cables now and proceed south, away from the bridge until out of the area of free cables, then return *over* the bridge, repeat over. There will be loose cables below. Commands now for even numbered subs: Turn north at once and into the current, full power ahead, rise at same time to level of the bridge. Execute."

It was a desperate maneuver, a plan conceived in a few moments in an attempt to master this unforeseen situation, a complicated stratagem that had to be enacted faultlessly in the midnight deeps where every man and every sub was separate and alone, yet interdependent. In his mind's eye Gus could see the bridge and he went over what must be done again in detail and was convinced that he was attempting the only thing possible.

The floating bridge was secured to its pier at one end only, the opposite end on the eastern cliff. With the west end unattached the current

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would push against the structure, bending it down-current to the south, bending it more and more until it broke and water flooded the air-filled tunnel section, robbing it of its buoyancy so it would hang downward, fracturing and being destroyed along its entire length. This could not happen!

The first thing he had to do was detach all the odd numbered subs which, like his own vehicle, had been towing the bridge from the southern, down-current, side. If any attempt was made to pull on the bridge with these cable moorings from the up-current side, they would twist the bridge as though trying to wind it up and this would destroy it as quickly as the current. If all was going correctly the odd numbered subs would have released their cables by now and would be fleeing up over the bridge; *Nautilus II* was below the freed cables so she could swing up-current and rise to join the subs that remained attached to their mooring cables. These would be fighting to keep the bridge from bending, pulling in a northerly direction with the full power of their engines. Pray they would succeed!

As the *Nautilus II* churned upwards they saw a horrifying sight on their screens, the view from their topside pickup. The row of lights on the bridge was no longer a straight line, but had curved instead into a monstrous letter *C* where the free end was being swept south by the current. Gus took one look then immediately snapped on the command circuit.

"To all subs that have dropped their cables: Rejoin others above who are attempting to hold the position of the west end of the bridge, use your magnetic grapples to secure to these subs then use full reverse power as well. We *must* stop the bridge from bending, we must straighten it."

Nautilus II led the way, nuzzling up beside one of the straining subs, touching her, then being held fast as the powerful electromagnet on the hull seized tight to the other. As soon as they were attached the engines whined, louder and louder, as they sped up to full reverse revolutions. If this helped it was not immediately visible for the bridge bent and bent even more until the free end was pointing almost due south. The designers had allowed for flexibility, but certainly not for this much, it would surely break at any moment.

Yet it did not. One by one the other subs latched on to their mates and added their power to the total effort. They could not straighten out the frightening bend but it appeared they had it checked at last. They were not gaining, but at least they had stopped losing. They needed more power.

"Attention all units of Section Two. Continue attaching cables your end. We are barely holding here. As each unit secures its cable proceed at maximum speed to this end and

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grapple to another sub. We need your help."

It came. One after another the other submarines swam up out of the darkness and ran their hulls against the subs already there until they clustered together like grapes, two, three and four in a group, straining at the cables. At first there seemed to be no result, try as hard as they could, then—Was it happening? Was the curve shallower? It was almost impossible to tell. Gus rubbed at his eyes as O'Toole spoke.

"Sure and I'm not the one to be making empty claims, but it's my feeling that we're moving astern just the smallest amount." No sooner were the words from his mouth than the communicator buzzed.

"*Anemone* here. I am in position near the cliff face and have been observing. Southern motion stopped. We appear now to be moving north at a very slow, but steady, pace."

"Thank you, *Anemone*," said Gus. "Well done. Can you hear me, *Periwinkle?*"

"*Periwinkle* here."

"You have the heavy grappling equipment. Proceed up to the free section of the bridge and locate the second cable on the southern side. Repeat second cable, labeled *Number Three.* The first cable was anchored but tore free. Follow this cable down to the orange marker, grapple there and attempt to attach to mounting Number Three. Do you understand?"

"I'm on my way."

Pulling mightily, engines flat out, the reluctant bridge was dragged against the current until it was in the correct position, to be held there while *Periwinkle* grappled cable after hanging cable and attached them. Only when all the down-current cables had been attached did Gus allow the cables they were tugging at to be grappled and put in position. As soon as the first one was down and secured he permitted himself to relax, to draw in a deep shuddering breath.

"One crew, one sub destroyed," he said to himself as memory returned after the endless period of effort. He was not aware of O'Toole and the others looking at him with something resembling awe, nodding agreement when O'Toole spoke.

"You did it, Captain Washington, you did it despite the quake. No one else could have—but you did it. Good men died, but no one could have prevented that. Still the bridge is in place and no more casualties. You did it!"

XII

"You are through to Sunningdale," the club porter said. "If you will take it in the telephone room, sir."

Washington nodded and hurried to the glass-doored chamber with its leather armchair and brocade walls. The loudspeaker was built into the wings of the chair by his head, the switch at his fingertips in the arm,

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the microphone before his lips. He sat and threw the switch on.

"Are you there? Washington speaking."

"Gus, is that you? How nice of you to call. Where are you?"

"At my club, London. Joyce, I wonder, could I ask a favor of you?"

He had met Joyce Boardman a number of times, taking her to lunch in London when he was in town, for she still saw a good deal of Iris. Joyce, happily married, knew how sorely he was troubled and without his asking told him all she knew of Iris, all that had transpired since last they had met. It was small solace, but it was something, and both of them enjoyed these luncheons though the real reason for their meetings was never mentioned. Now there was silence for a moment on the line before Joyce answered, since he had asked nothing of her before.

"But of course, anything within reason, you know that."

Now it was Gus's turn for silence for he felt a certain embarrassment in speaking his mind like this; he clenched his fist hard. He had to say it.

"It's a, well, personal matter as I am sure you have guessed. You read the papers, so you know that the tunnel is just about completed, in fact I am in London for the final arrangements. I leave in the morning for New York which should wind things up, the opening train coming up and all that, but pretty well finished here. What I would like, I cannot do it directly, I wonder—if you could arrange a meeting with Iris."

He brought the words out in a rush and sat back; he had said it. Joyce laughed and he felt the flush rising in his face before she hurried to explain.

"Excuse me please, I was laughing, you know, because of the coincidence, just too uncanny. Do you remember that first night we met, at the Albert Hall?"

"I am sure I will never forget it."

"Yes, I realize, but there was this speaker there, the philosopher and scientist Dr. Judah Mendoza, the one with all the time theories, really fascinating indeed. I've been to all his lectures, sometimes with Iris, and this afternoon he will be at my home, a small soiree, along with the medium Madame Clotilda. She doesn't work well before large audiences so this has been arranged. Just a few people. You're welcome to come of course. Two o'clock. Iris will be here as well."

"The perfect thing, I'll be ever grateful."

"Tush. I can count on you then?"

"You could not keep me away!"

Gus saw nothing outside during the cab ride and the short train trip into the countryside, for his eyes were looking inward. What could he do? What could he say? Their futures were in the hands of Sir Isambard and at that morning's meeting he had seemed as crusty as ever, even with the tunnel finished. Could

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he possibly change? *Would* he change? There were no easy answers.

It was a kindly summer day, the old houses on each side of the curving street surrounded by a wealth of colorful blossoms replete with bees droning about with their burdens of nectar. Weathered wood, russet tiles, green lawns, blue sky, a perfect day, and Gus drew heart. With the world as peaceful as this, the tunnel almost done, there must be an understanding between them. Too many years of sacrifice had gone by already; there had to be an end to it.

A maid showed him in when he rang and Joyce, in a floorsweeping dress, came to take his hand. "Iris will be here at any moment--come and meet the others."

The others were mostly women, none of whom he knew, and he mumbled his hellos. There were two men, one of them a bearded professor of some sort who had crumbs of food on his lapels, a thick German accent, and bad breath. Gus quickly took his sherry and seated himself by the other man, also an academic but one at least of whom he had heard, Reverend Aldiss, the warden of All Souls. The warden, a tall, erect man with an impressive nose and jaw, was having no trifle with sherry but instead held a large whiskey in his hand. For a moment Gus wondered what he was doing here, then remembered that in addition to his college work the warden had no small literary reputation as the author of a number of popular scientific romances under the *nom de plume* of Argentmount Brown. These parallel-world theories were undoubtedly meat and drink to him. They talked a bit, for the warden had a keen interest in the tunnel and a knowledge of the technical problems involved, listening closely and nodding while Gus explained. This ended when Iris came in; Gus excused himself abruptly and went over to her.

"You are looking very good," said he, which was only the truth, for the delicate crow's-feet in the corners of her eyes made her more attractive if anything.

"And you, keeping well? The tunnel is approaching completion, Father tells me. I can't begin to explain how proud I am."

They could say no more in this public place, though her eyes spoke a deeper message, one of longing, of solitary days and empty nights. He understood and they both knew that nothing had changed between them. There was time only for a few more polite words before they were all called in; the séance was about to begin. The curtains had been drawn shut so that only a half light filtered into the room. They sat in a semicircle facing Dr. Mendoza who stood with his back to the fireplace, hands under coattails as though seeking warmth from the cold hearth, while beside him the rotund Madame Clotilda lay composed upon the sofa. Mendoza coughed loudly until he had absolute silence, patted his

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skullcap as though to make sure it was in place, stroked his full gray beard, which indubitably was still there, and began.

"I see among us this day some familiar faces as well as some I do not know, so I venture to explain some of the few things we have uncovered in our serious delving. There is but a single alpha-node that has such a weight of importance that it overwhelms all others in relation to this world as we know it, and to the other world we have been attempting to explore which is our world, one might say, as we do *not* know it. This alpha-node is the miserable shepherd Martin Alhaja Gontran, killed in 1212. In this other world we examine, which I call Alpha 2, ours of course being Alpha 1, the shepherd lived and the Moors did not win the battle of Navas de Tolosa. A Christian country by the name of Spain came into existence in the part of the Iberian Peninsula we know as the Iberian Caliphate, along with a smaller Christian country called Portugal. Events accelerate, these brawling, lusty new countries expand, send settlers to the new worlds, fight wars there, the face of the globe changes. We look back to England for a moment, since this is the question asked me most often, what of England? Where were we? Did not John Cabot discover North and South America? Where are our brave men? The answer seems to lie in this world of Alpha 2 with a debilitating English civil war called, oddly enough, we cannot be sure of all details, the War of the Tulips, though perhaps not, Madame Clotilda was unsure, England not being Holland, perhaps War of the Roses would be more exact. England's substance was spent on internal warfare, King Louis the Eleventh of France living to old age, involved in English wars constantly."

"Louis died of the pox at nineteen," Warden Aldiss muttered. "Good thing, too." Dr. Mendoza blew his nose on a kerchief and went on.

"Much is not explained and today I hope we will clear up some of the difficulties, for I will attempt to forget history and all those strange Spanish-speaking Aztecs and Incas, most confusing indeed, and we will try to describe the world of Alpha 2 as it is today, this year, now. Madame, if you please."

They looked on quietly as Dr. Mendoza made the elaborate passes and spoke the incantations that put the medium into her trance. Madame Clotilda sank into an easy sleep, hands clasped on her mountainous bosom, breathing smoothly and deeply. But when the doctor attempted to bring her into contact with the Alpha 2 world she protested, though still remaining unconscious, her body twitching and jiggling, her head tossing this way and that. He was firm in his endeavors and permitted no digressing so that in the end his will conquered hers and she acquiesced.

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"Speak," he commanded, and the order could not be disobeyed. "You are there now in this world we know and spoke of, you can see it about you, tell us of it, tell us of England, the world, the colonies, speak, tell us, inform us, for we want to hear. *Speak*!"

She spoke, first rambling words, out of context perhaps, nonsense syllables, then clearly she described what never had been.

"Urhhh . . . urrhhh . . . penicillin, petrochemicals, purchase tax . . . income tax, sales tax, anthrax . . . Woolworth's, Marks & Sparks . . . great ships in the air, great cities on the ground, people everywhere. I see London, I see Paris, I see New York, I see Moscow, I see strange things. I see armies, warfare, killing, tons, tons, tons, tons of bombs from the air on cities and people below, hate him, kill him, poison gas, germ warfare, napalm, bomb, big bombs, atom bombs, hydrogen bombs, bombs dropping, men fighting killing dying, hating, it is, it is . . . ARRRRRH!"

She ended with a scream and her body flopped about like a great rag doll tossed by some invisible beast. Gus rushed forward to help but Dr. Mendoza waved him away as a doctor appeared from the kitchen where he had been waiting, undoubtedly in case of a seizure like this. Gus went back to his chair and saw a startled face appear in the doorway behind. The master of the house, Tom Boardman whom he had met once, took one wild-eyed look at the incredible scene in his drawing room, then fled upstairs. Mendoza was speaking again, mopping his face at the same time wih his bandanna.

"We can hear no more, Madame will not approach this area, she cannot stand it, as we can see why instantly. Such terrible nightmare forces. Hearing of it we are forced to some reluctant conclusions. Perhaps this world does not exist after all, for it sounds terrible and we cannot possibly imagine how it could have become like that, so perhaps it is just the weird imaginings of the medium's subconscious mind, something we must always watch for in these investigations. We will pursue the matter deeper, if we can, but there seems little hope of success, of possibly contacting this world as I once hoped to. A false hope. We should be satisfied with our own world, imperfect as it may be."

"Are there no more details of it?" Warden Aldiss asked.

"Some; I can supply them if you wish. Perhaps they are more suitable for a scientific romance than for reality. I for one would not enjoy living in the world so described."

There were murmurs of assent from all sides of the room and Gus took the opportunity to take Iris's hand and lead her from the room, through the French windows and into the garden. They walked under the apple trees, already heavy with fruit, and he banished the memory

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of the recent strange experience from his mind and spoke of the matter closest to his heart.

"Will you marry me, Iris?"

"Would that I could! But—"

"Your father?"

"He is still an ill man, he works too hard. He needs me. Perhaps when the tunnel is done, I'll take him away somewhere, make him retire."

"I doubt if he will ever do that."

She nodded agreement and shook her head helplessly. "I am afraid that I doubt it, too. Gus, dear Gus, is there to be no future for us after all these years of waiting?"

"There has to be. I will talk to him after the inaugural run. With the tunnel completed our differences should no longer count."

"They will still count with Father. He is a stern man."

"You would not leave him to marry me?"

"I cannot. I cannot seek my own happiness by injuring another."

His logical mind agreed with her and he loved her even the more for her words. But in his heart he could not bear the answer that would keep them apart. Torn, unhappy, they reached out and clasped hands tightly and looked deep into the other's eyes. There were no tears in Iris's eyes this time, perhaps because they had been shed all too often before. A cloud crossed the sun and darkness fell across them and touched deep into their hearts as well.

XIII

What a day, what a glorious day to be alive! Children present on this day would grow old with memories they would never forget, to sit by the fire some future evening and tell other wide-eyed children, yet unborn, about the wonder of this day. A cheerful sun shone brightly on City Hall Park in New York City, a cooling breeze rustled the leaves upon the trees while children rolled hoops and ran merrily about among the slowly promenading adults. What a microcosm of the New World this little park had become as people flocked in for this wonderful occasion, a slice of history revealed with the original owners there, the Lenni-Lenape Indians, a few Dutchmen, for they had been intrepid enough to attempt a colony here before the English overwhelmed them, Scotch and Irish who then came to settle, as well as immigrants from all the countries of Europe.

And Indians and more Indians, Algonquins of all the five nations in their ceremonial finery of tall feathered headdresses; Blackfeet and Crow from the west, Pueblo and Pima from even farther west, Aztec and Inca from the south resplendent in their multicolored feather cloaks and ceremonial axes and war clubs—black rubber inserts replacing the deadly volcanic glass blades, Maya as well and members of the hundreds of other tribes and nations of South America. They strolled about,

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all of them, talking and pointing and enjoying the scene, buying ice cream, tortillas, hot dogs, tacos and hot chillies from the vendors, balloons and toys, fireworks and flags galore. Here a dog ran barking chased by enthusiastic boys, there the first inebriate of the day was seized by one of the blue-clad New York's Finest and ushered into the waiting paddy wagons. All was as it should be and the world seemed a wonderful place.

Just before the City Hall steps the ceremonial reviewing stand had been set up, flag-draped and gilt-laden, with the microphones for the speakers in front and a lustily worked orchestra to the rear. Occasional political speakers had already alluded to the greatness of the occasion and their own superlative accomplishments, but were as little heeded, and in a sense provided the same sort of background music, as the musicians who played enthusiastically in between the speeches. This was of little more than passing interest to the crowd, though of course they enjoyed the melodious sounds, for they had come to see something else, something astonishing, something more memorable than politicos and piccolos. A train. *The* train, shining brilliantly in the sunshine. Sand had been spread right down the middle of Broadway and sleepers laid in the sand and tracks laid on the sleepers and not a soul had complained about the disruption of traffic because, during the night, the train had backed slowly down these tracks with the soldiers marching on each side to this spot to await the dawn.

So there it was, the railings of the observation platform of the last car close to the reviewing stand, the gleaming cars stretching away down the tracks, glistening in the sun a deep, enameled ocean blue picked out with white about the windows, the official tunnel colors. Resplendent on each car in serifed and swirled gold letters was the proud legend: THE TRANSLATLANTIC EXPRESS. Yet, fascinating as these cars were, the crowd was gathered thickest about the engine, pressing close to the barricades and the rigid lines of soldiers behind them, tall, strong men of the First Territorial Guards, impressive in their knee-high boots, Sam Browne belts, ceremonial tomahawks and busbies, bayonet tipped rifles to the fore. What an engine this was!, sister of the mighty *Dreadnought* which pulled the English section, *Imperator* by name and imperious in the splendor of its sleek, sterling silver-plated outer works. It was said that the engineer of this great machine had a doctorate from M.I.T., and he probably did since this engine was propelled by an atomic reactor as was *Dreadnought*.

Now the lucky passengers were arriving, their cars pulling up in the cleared area on the far side of the train for boarding, all of the rich, affluent, influential, beautiful people

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who had managed to obtain passage on this inaugural run. Cheers went up from the crowd as various prominent figures made their appearance and were ushered aboard. The clocks in the steeple of City Hall pointed closer and closer to the hour of departure and the excitement quickened as the final orotund syllables of the last orations rolled across the crowd. On the observation platform of the train the chairman of The Transatlantic Tunnel Board, Sir Winthrop, was making an address that those close by listened to with some interest, but which could not be heard in the rearmost reaches. Now there was a stirring in these outer ranks and a sudden chant, building up louder and louder until it all but drowned out the speaker.

"WASH-ING-TON! . . . WASH-ING-TON! . . . WASH-ING-TON!"

Louder and louder until the entire audience joined in and Sir Withrop, bowing to the public will, smiled and waved Augustine Washington forward. Cheers echoed from the tall buildings on all sides so explosively that the well-fed pigeons rose up in a cloud and swooped over and around in a fluttering flock. The cheering went on, even more loudly if that were possible, until he raised his hands over his head, and then it died away. Now there was a real silence because they wanted to listen to him and remember what he said for he was the man of the hour.

"Fellow Americans, this is an American day. This tunnel was dug and drilled and built by Americans, every mile of the way to the Azores Station. Americans died in its construction but they died in a worthy cause for we have done something that has never been done before, built something that never existed before, attained a victory never achieved before. This is your tunnel, your train, your success, for without the iron will of the American people behind it it would never have been done. I salute you and I thank you and I bid you good-bye."

After this there was no end to the cheering and even those closest in could not hear a syllable of the speech by the Governor General of the American colonies, which perhaps was no tragedy after all. When he had done his lady stepped forward, said a few appropriate words, then broke a bottle of champagne against the train. It was only a stentorian blast from *Imperator's* whistle that brought silence at last, while those closest to the engine clapped hands to ears. Now sounds could be heard from the countless loudspeakers set on poles about the park, far distant sounds echoed by similar sounds here because these were broadcast radio signals sent directly from Paddington Station in London.

All aboard! was repeated by the conductor here, while the whistles of trainmen echoed identically on both sides of the Atlantic. So hushed were the people that only the train sounds could be heard now, the slamming of

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doors, shouted instructions and more whistles until finally, as the hands touched the hour, the releasing of brakes and the deep clatter of metal sounded as the two trains slid smoothly into motion.

At this instant there was no restraining the crowd who cheered themselves hoarse and ran after the receding train waving enthusiastically. Washington and the other dignitaries on the train waved back through the transparent canopy that had dropped into place over the observation platform. The trip had begun.

As soon as the train entered the tunnel under the Hudson River, Gus went to the bar car where he was greeted and applauded loudly and offered a good number of drinks, one or two of which he accepted. However as soon as they had emerged in Queens he excused himself and went to his seat and was pleasantly surprised to find the compartment empty; apparently the others were all in the crowded car he had just quitted.

At that moment he was more than content to sit looking out of the window as the little homes flashed by, then the meadows and farms of Long Island, while his thoughts and memories moved with the same kaleidoscopic quality. The labor done; it was hard to realize. All the men and the hundreds of thousands of hours of grueling effort that had gone into it, the tunnel sections and the rails, the underwater dredging, the submarine operations, the bridge, the railhead. All done. Faces and names swam in his memory and if he had permitted himself to be tired he would have been possessed by the most debilitating of fatigues. But he did not for he was buoyed up by the reality of the success. A transatlantic tunnel at last!

With a rush of air the train dived into the tunnel mouth at Bridgehampton and out under the shallow Atlantic. Faster and faster, just as his thoughts went faster and faster, until they slowed and emerged in the sunlight of the Grand Banks Station, sliding into the station with the tubular cars of the deep-sea train section just across the platform. Normally the passengers would just stroll across to the other train while their containerized luggage was changed as well, a matter of a few short minutes. But today an hour had been allowed so the people aboard this inaugural trip could look about the artificial island.

Gus had often enough seen the docks where the fishing boats unloaded their catch, the train yards and goods depots, so he crossed over and sat once again by himself, still wrapped in thought, while the chattering passengers returned and found their places, oohing at the luxurious appointments, aahing as the pneumatic doors *whooshed* into place and sealed themselves shut. Ponderous valves opened and the wheelless train floated forward into the long and shining steel chamber that

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was, in reality, an air lock. With the door sealed and shut behind, the pumps labored and the air was removed from around them until the entire train hung unsuspended in a hard vacuum. Only then did the seal open at the other end as the sleek silvery length slid into the evacuated tunnel beyond and began to pick up speed.

There was no sensation inside the train as to how fast they were going, which was a good thing since, as they rushed down the slope of the Laurentian Cone, they went faster and faster until their top speed was near 2,000 miles an hour. Since there was nothing to see outside the passengers soon lost interest and ordered drinks and snacks from the hurrying waiters and even broke out packs of cards for their amusement.

But Gus could see the outside landscape in his memory, the covered trench on the ocean bed that hurtled towards the great valley of the Oceanographic Fracture Zone and across the floating bridge at its center. Good men had died here and now they were through the tunnel and over the bridge and past in an instant and already beginning the climb up to the Azores Station, to once again glide into an air lock, only this time to have the air admitted from the outside.

Unknown to the passengers both trains had been running under the guidance of the Brabbage computer which had apportioned certain amounts of time for the stops at the two intermediate stations, then had controlled train speeds as well so that now, as the American section of the Transatlantic Express slid slowly into the station, the English section was also approaching from the opposite direction, a beautifully timed mid-Atlantic meeting as both braked to a stop at the same instant.

Only a brief halt was scheduled here, for a few speeches, before the trains went their respective ways. Gus was looking out at the train opposite and at the waving crowd in its windows, when there was a tap on his shoulder so that he turned to face a uniformed trainman.

"If you would come with me, Captain Washington."

There was an edge of concern to the man's voice that Gus caught instantly so that he nodded and rose at once, hoping that the others had not heard; but they were too involved in the novelty and the excitement to be very aware. The trainman led the way to the platform and Gus queried him at once.

"Not sure, sir, something about Sir Isambard. I was told to bring you at once."

They hurried across to the waiting train and there was Iris who took him by the hand and led him down the passage out of earshot of the others.

"It's Father. He has had another attack. And he asked to see you. The doctor is afraid that . . . that . . . She could not finish and the tears so

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proudly held back until now burst forth.

Gus touched his handkerchief lightly to her eyes as he said, "Take me to him."

Sir Isambard was alone in the compartment, except for the ministering physician, and the curtains were drawn. They let themselves in and with a single look at the blanket-wrapped figure Gus knew that the matter was very grave indeed. The great engineer looked smaller now, and much older, as he lay with his eyes closed, his mouth slightly open and gasping for air; his lips had a definite bluish tinge to them. The physician was administering an injection to the flaccid arm and they waited until he had done before speaking.

"Daddy," said Iris, and could speak no more. His eyes opened slowly and he looked at her for long seconds before speaking.

"Come in . . . . both . . . come in. Doctor, I am weak . . . too weak . . ."

"It is to be expected, sir, you must realize—"

"I realize I need something to sit me up . . . so I can speak. An injection, you know what I need."

"Any stimulants at this time would be definitely contraindicated."

"A fancy way of saying . . . they will kill me. Well, I'm dying anyway . . . keep the machine running a bit longer is all I ask."

It took the physician but a moment to reach a decision—then he turned to his bag and prepared his medicines. They waited in silence while the injections were made and a touch of color washed through the sick man's cheeks.

"That is much better," said he, struggling to sit up.

"A false illusion," the doctor insisted. "Afterwards—"

"Afterwards the afterwards," Sir Isambard said with some of his old manner returned. "I mean to see this inaugural run completed and I'll do it if I have to be carried to the end on the tips of your infernal needles. Now clear out until we reach the Grand Banks Station where I'll need your aid to change trains." He waited until the door had closed then turned to Gus. "I have played the fool, I can see that at last."

"Sir—"

"Do not interrupt. The tunnel is built, so our quarrels are at an end. If they ever existed, that is. As I come closer to my Maker and that eternal moment of truth I see that perhaps most of the troubles were caused by my denying your ability. If so I am sorry. More important I feel that in my selfishness I have made two others suffer, and for this I am infinitely more sorry. At one time I believe you two wished to be wed. Do you still?" Iris answered for them both, with a quick nod of her head, while her hand crept out and found Gus's. "Then so be it. Should have been done years ago."

"I could not leave you, Father, nor will I. It is my decision."

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"Nonsense. Marry him quick because you won't have to worry about caring for me much longer."

"You won't—!"

"Yes I will. I had better. Man can only make a fool of himself on his deathbed, or admit he's been a fool. After that he had better die. Now send that physician fellow in for I need a bit more help."

It was the mighty will inside that frail body that kept it going, for the attack should have felled him long since. Medicine helped, as medicine does, but it was the strong spirit that buoyed him up. At the Grand Banks Station a stretcher was waiting and he was carried across to the other train while the passengers were rushed in their transfer; no sightseeing this time. Down into the tunnel again with Sir Isambard staring ahead fixedly, as though all his will were needed for the process of breathing and staying alive, which perhaps it was. A few minutes later the door opened and Gus looked up, then hurriedly climbed to his feet while Iris curtsied towards the young man who stood there.

"Please, don't bother," said he. "We were all concerned about Sir Isambard. How is he?"

"As good as might be expected, Your Highness," answered Gus.

"Fine. Captain Washington, if you have a moment my mother would like to speak with you."

They left together and Iris sat by her father, holding his cold hand in both of hers until Gus returned.

"Well?" Sir Isambard asked, his eyes opening at the sound of his entry.

"A very fine woman indeed. She congratulates us all on this work. Then she mentioned a knighthood—"

"Oh, Gus!"

"—Which I refused, saying that there was something I wished more, something for my country. She understood completely. There has been much talk of independence since the tunnel began and apparently the foreign minister, Lord Amis, has been after her continually, seeing more good in the colonies, she says, than he does in England at times. It seems that the wheels have been working below the surface and there *will* be independence for America at last!"

"Oh Gus, darling, then it has happened! What you have always wanted."

"Should have taken the knighthood, let the damned colonies take care of themselves."

Sir Isambard looked out of the window and fretted while they kissed, long and passionately, until with a rush and a burst of light the dark tunnel ended and the green potato fields of Long Island appeared.

"So there," Sir Isambard said, with some satisfaction, stamping his cane on the floor. "So there! Transatlantic tunnel, under the entire ocean. A wonderful day."

He closed his eyes, smiling, and never opened them again.

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XIV

Across the verdant Cheshire countryside the churchbells sounded their merry call and anyone hearing them could not but smile at their pleasant sound. The church itself, an ancient graying Norman pile of Bulkeley, close by the ancestral Brassey manor of Bulkeley Old Hall, was so surrounded by hedge and flowers that only its tower was visible from the road. Behind it, bordered by the color and perfume of a carefully tended rose garden, was a small yard and here three friends stood.

"I can never thank you too much," said Gus Washington.

"Nonsense!" Alec Durell answered. "A distinct pleasure to stand up for you. Never been a best man before, in fact haven't been in

the analytical laboratory

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PLACE	TITLE	AUTHOR	POINTS
1.	Child of the Gods	*James Schmitz*	2.39
2.	Cloak of Anarchy	*Larry Niven*	2.69
3.	The Gold at the Starbow's End	*Frederik Pohl*	2.97
4.	War in Our Time	*Howard L. Myers*	3.94
5.	BCL 362	*Vernon Glasser*	4.10
6.	The Long Silence	*Donald Noakes*	4.47

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church for donkey's years. In any case, plenty of perks involved. Bit of extra leave, more credit with my tailor for this morning suit, always needed one, chance to kiss the bride. In fact think I'll try that again."

And he did while Iris's eyes shone and she laughed aloud, a vision in white and lace, happy as only brides can be.

"You are sure that you cannot stay for the reception?"

"Positive. Love to, of course, but duty calls. Signed off the old wombat of the Queen Elizabeth, too much of a milk run, back and forth across the Atlantic, might as well go under it in your tunnel like everyone else, for all I saw of it in my engine rooms. Took up my commission again, I did, Queen's shilling and all that, and they were damned glad to have me."

"Couldn't run the R.A.F. without you," Gus laughed.

"Too true," he lowered his voice and looked around. "Strictly confidential now—you read the papers of course so you know about this spot of nastiness on the Continent. Count upon foreigners to make trouble any time. It's the Saxons again, almost as bad as the Prussians, this time after the French. They have been trading shells back and forth across the Rhine which no one cares about as long as they blow up a few pigsties and such, but they hit one of the resort towns with the H.E., blew off the front of the hotel. Can't have that, British subjects staying there. Being evacuated of course, but still. That's what battleships are for, as someone said."

They walked him as far as the garden gate where, after shaking Gus's hand, he was presumptuous enough to kiss the bride again, something that, surprisingly enough, none of them seemed to mind.

"I'm on the *Invincible,* sister ship to the old *Courageous,* supposed to be identical but ten years more modern in every way. Four stokers in my engine room so we can feed the furnaces manually if the automatic equipment goes out. Fourteen steam turbines spinning her props, seven in each wing. The range is a secret but it is really something, I can assure you, plenty of armament, light and heavy machine guns, small cannon in turrets on top of the twin tails, with two seven-inch recoilless cannon in a turret in her nose. Just wait until she flies along the old Rhine and puts a few bursts across their bows, they'll think twice about shelling Englishmen!"

He started down the lane, shoulders back in the best military manner, then turned to wave with a most unmilitary smile at the happy couple who stood, arms about one another, and called out.

"Meant to congratulate you on the American independence. A good thing. Why don't you run for President, Gus, President Washington, has rather an odd sound but a nice one. I bet you could do it."

Whistling, he went around the turning and out of sight. ■

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THE REFERENCE LIBRARY

P. Schuyler Miller

ENGLAND STILL SWINGS

When Judith Merril published her "England Swings" anthology to introduce American readers to the just breaking "new wave" of English speculative fiction, she was also taking advantage of the popularity of the song of the same title. What she didn't do is carry the parallel all the way. English science fiction was swinging like a pendulum—just as in the song—from the wholly conventional to the far, far out.

It still is, and there are a variety of American paperbacks to prove it.

Back in the years when the original *New Worlds* was an English counterpart of Analog, its editor and publisher was John Carnell. For some time, now, he has been publishing what must be the oldest continuing series of anthologies of original science fiction, at a rate of two or three a year. Dobson publishes a hardback edition; Corgi follows with an English paperback; and Bantam has been rather dragging along with American editions. Whereas the English series had reached "SF 19" by the end of 1971, the latest I have seen from Bantam is "SF 7" (No. S5998; 168 pp.; 75¢). However, it isn't a reprint of the English "SF 7" . . . it is a mixture of stories from three books: Numbers 7 (three stories), 8 (only one), and 9 (three).

These stories are the kind of science fiction "Ted" Carnell published in his *New Worlds*, and some of them would do very well here, or would have in 1966, when they first appeared. The three best are Colin Kapp's "The Pen and the Dark," a technical puzzle in which scientists try to interpret and understand a set of created phenomena; John Rankine's "Six Cubed Plus One," in which some careless wiring converts a battery of teaching machines into an educational monster; and Vincent King's "Defense Mechanism," a far-future story in which near-savage survivors of a holocaust hunt aliens through the ruins of a megalopolis that must have been much like the world city of Robert Silverberg's "The World Inside."

The rest are competent enough old-line science fiction except for one fantasy, Douglas Mason's "The Man Who Missed the Ferry," a matter-of-fact account of a man who walks on water. Robert Presslie's "The Night of the Seventh Finger" is a haunting story about future teen-

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agers and an android lost in time. William Spencer's "The Long Memory" suggests the limits to which total government surveillance may go. And Arthur Sellings's "Gift of the Gods" is a very slight gimmick story, in which strange objects appear out of nowhere in the English countryside.

At the opposite extreme, *New Worlds* has now metamorphosed into a series of quarterly paperbacks, published by Berkley and edited by Michael Moorcock, who made the magazine into the *avant garde* publication I've described here before. Here "SF" very definitely means "speculative fantasy"—which may include very good science fiction. I'm told that the University of Pittsburgh bookstore had a few copies of No. 2, but No. 1 is all I've seen. It is Berkley No. N2074; contains ten stories and an article condemning conventional science fiction; and gives you 192 pages for 95¢.

One of the ten is supernatural fantasy—the kind Fritz Leiber writes, and as good: M. John Harrison's "The Lamia and Lord Cromis," in which a feudal lordling hunts down the family monster. Brian Aldiss's "The Day We Embarked for Cythera" is called fantasy by Moorcock in his introduction, but you can very well read it as a vignette from the far future, when tourists from another planet are visiting the moribund Earth, where men and machines have grown decadent.

J. G. Ballard, the bellwether of the new wave, is here twice. "A Place and a Time to Die" is one of his "conventional" stories, about a future in which American invaders are protecting England from itself in an extrapolation that has gone beyond Cambodia and Laos to encompass most of the world. "Journey Across a Crater," on the other hand, is one of his fragmented "stories," told as if a Persian miniature painted on porcelain had been shattered, and you could see only a few fragments, with no assurance that they are in their proper relationship to each other.

John Sladek has two stories, also. "Pemberly's Start-Afresh Calliope" is perhaps an allegory, perhaps an acid dream, perhaps nothing for which we have words. "The Short Happy Wife of Mansard Elliot" is equally surrealistic. What they mean, if they mean anything, is your problem: they're pure new wave "SF."

Two of the stories, Thomas M. Disch's "Angouleme" and Keith Roberts's "The God House," are parts of on-going series which may eventually appear as novels—an old new *New Worlds* convention. They are both relatively conventional and might have appeared anywhere—but that was, and is, the essence of *New Worlds* in the Moorcock era. "Angouleme" shows us children in New York of a decade or two from now—perhaps the period of Anthony Burgess's "A Clockwork Orange." These ten-year-olds decide to kill someone, simply because it seems something

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they should do. "The God House," set in an era of future savagery, does give us a thoroughly real and hard-nosed character in Mata, a woman's lib type who takes over and reconstructs her tribe's superstitions in a completely ruthless way.

There are two stories left, David Redd's "Prisoners of Paradise" and Barrington Bayley's "Escape from City 5." Redd's story is one of the best, a portrait of an alien who discovers a new form of art in the delirium of a dying spaceman. Bayley's story, on the other hand, combines "hard SF" with the experimental techniques in an account of a self-contained city that has escaped from the physical universe into a kind of limbo outside of space and time. It has elements of the final episodes in James Blish's "Cities in Flight" series.

Linking the two books is a collection of stories from *New Worlds* as a magazine, one of a series that Berkley will probably replace by the new quarterly book-magazine. The last I saw—and would have reported here if "No. 1" hadn't appeared—was "The Best Stories from New Worlds 6" (Berkley No. S2075; 75¢). We don't have room for it here, but I'll give it a separate write-up that Ben Bova may use if he's really hard-pressed.

THE LATHE OF HEAVEN
by Ursula K. Le Guin • Charles Scribner's Sons, New York • 1971 • 184 pp. • $4.95

This is a more conventional science-fiction story than the author's double award winner, "The Left Hand of Darkness." It is also a poorer book, which may be carried into the 1971 finals by the reputation of her earlier work, but doesn't really belong there.

It goes back to that old philosophical gimmick used by so many writers over the years: the world is what you think it is. It also harks back to a Victorian novel and play which I saw far too many years ago to count, "Peter Ibbetson." Peter (when he crossed his ankles properly—as I find myself doing still) "dreamed true." So does George Orr, the draftsman in this book—but what he dreams doesn't put him in telepathic contact with his girlfriend. It changes the world . . . the universe.

Orr reaches the point where he doesn't dare let himself sleep. He lives not very far from our time, in the ugly, overcrowded world you can see growing all around you, and he doesn't like it any more than you do—but the results of his dislike scare him. When drugs can't keep him in line any longer, he winds up on the couch of a psychiatrist—who is shortly conditioning George's dreams in order to remake the world in his image.

But dreams are slippery things, and in time they bring an alien invasion down upon the world they have previously depopulated and rebuilt.

It's well enough done. It's better

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than most other books in the same vein. It just isn't up to Mrs. Le Guin's own standard.

A CHOICE OF GODS

by Clifford D. Simak • G. P. Putnam's Sons, New York • 1971 • 190 pp. • $4.95

This is the strangest of the very strange books old pro Simak has been writing of late. It's apparently an original, too; at least, there are no prior publication credits.

The story is as far out as "Out of Their Minds" or "The Goblin Reservation," but it is much less fantastic and closer to conventional science fiction. The author has also used his "pastoral" strain lovingly enough to make the old country boy in me nostalgic.

In the future in which the story takes place, nearly all of mankind has been carried off in a night and strewn among the stars. A few were missed, for reasons which are one of the problems of the story. Among them are Jason and Martha Whitney, five thousand years older than when the rest of mankind vanished, and quietly doing their best to preserve a thread of the human world they remember. Their children have also gone to the stars, for it has turned out that the survivors have extraordinary powers of teleportation and telepathy: Martha talks to them across the span of the universe as if they were down the road on a rural telephone line.

A small Indian tribe, whose chief was in school with Jason, has drifted back into its ancient way of life, following the game and the seasons. (There are buffalo on the prairies again.) Near the Whitneys' home a small enclave of philosophical robot monks is trying to fathom the laws of human religion. Up the river another band of robots have built themselves a fantastic city-building. Out in the west other nomads are living almost on an Indian level—a young man wanders east and encounters an Indian girl, Jason's protegée, studying in his library. And out in the woods a sick, repulsive alien from the other side of Space huddles miserably in the dark, sick and afraid.

Then Jason's eldest son comes home from a probe toward the center of the Galaxy. Out there, at the focus of fantastic forces, he has found a being—a Principle—which may have stolen away mankind as an experiment or out of boredom, and which is about to show them the way home.

I have deliberately skirted around the real quality of the book. This is something the author must communicate to you himself. To me, it is more like "City" in mood than anything else he has written. But you should know its theme—the question it asks.

"What is God?"

THE DEVIL IS DEAD

by R. A. Lafferty • Avon Books, New York • No. V-2406 • 224 pp. • 75¢

Raphael Aloysius Lafferty is

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surely the phenomenon of the last decade in the SF world—and you can define those initials anyway you please. Alexei Panshin said of his award-pushing 1969 novel, "Fourth Mansions," that it is like a fantastic amalgam of A. E. Van Vogt and "The Circus of Dr. Lao." He should have saved the comment for this one. Poul Anderson called the other book "wild, subtle, demonic, angelic, hilarious, tragic, poetic, a thundering melodrama and a quest into the depths of the human spirit." I'm not too proud to use his cover blurb again. Which leaves Roger Zelazny with "a psychedelic morality play where the Virtues and Vices keep sneaking offstage and switching masks." Seconded and passed.

As a matter of fact, the two books have almost the same theme, only this one is better. It's the theme of all those superrace books by Van Vogt and others, which accounts for part of what Panshin said. The devil is in it, but he was in Lafferty first, and did good there.

On the surface, this is a story of the exploits and wanderings of a mismatched group who batter their way from Texas to the Aegean and back again. The ostensible hero is one Finnegan "of the other blood," who gets to be several other people from time to time as the book progresses. His sometime ally, sometime adversary is one Papadiabolous, which anyone can tell you means "Papa Devil," and The Devil he may well be—but he is killed in a private fight long before the book is over. There is also a mermaid of Greek origin and upbringing—one of the quietest and most persuasive parts of the book is her short explanation of the ancestry and genetics of mermaids. And there are other things too numerous to keep track of.

I love fantasy, and I put off reading this until I could relish it properly without having to dissect it for you. Then the impression grew on me that wild as it all was, it was just as good science fiction as ever you saw here. And so it is, but I recommend that you discover how and why by your own route.

Since I have used better men's enthusiasm to save my own shortage of words, let me have a final wise say of my own about Lafferty and how he writes. The "New Wave" has taken unto itself the banner of experimental writing, which to a dullard would seem to be the more imaginative and effective use of words. Yet it seems to me that most of the New Wave writers have a contempt for words—excepting, maybe, Ballard in his "straight" moods, and never for one moment including Zelazny, or Samuel Delaney, or even Harlan Ellison. They use them harshly and abuse them oftener than not.

Lafferty comes of an old school that relishes words and selects them with love and delight. He holds them up, and turns them around and about so that the light plays over them from every side and reveals little shades and colors you never

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knew were in them. He'll pelt you with them, and rake you with them, and drive them under your skin. His way, to hamstring another metaphor, is to breed new monsters and new marvels out of them—not to use the butcher's surgery of Dr. Moreau.

Artzybashev, you should be alive to adorn this book with your art as you did "The Circus of Dr. Lao."

RUSSIAN SCIENCE FICTION LITERATURE AND CRITICISM: A BIBLIOGRAPHY

by Darko Suvin • Toronto Public Library, 566 Palmerston Avenue, Toronto, Ontario, Canada • 1971 • 35 pp. • $2.00

I hope it hasn't escaped your attention that there is a vigorous science-fiction movement in the U.S.S.R. Only a few novels and collections of short stories, not always by the best writers, have been published in English—more in England than have yet been available in the United States—and I've tried to call your attention to them whenever I managed to find one.

This bibliography was compiled by Professor Darko Suvin of McGill University, Montreal, for the Secondary Universe conference held in Toronto last October. Dr. Suvin is the Yugoslav student of science fiction whose excellent anthology of SF from east of the Iron Curtain, "Other Worlds, Other Seas," was published by Random House in 1970.

You will be amazed, I think, at the number of science-fiction novels, short-story collections, and anthologies published in Russia in the fifteen years—1956-1970—covered by Part I of this bibliography. If you can read Russian, there is also a recommendation of a "minimum" library of modern Russian-language SF. The bibliography covers books only . . . not magazine fiction, and not stray stories in other collections.

Part II may be of more practical use, if you know where you can buy books published abroad. It is a three-and-a-half-page listing of Russian SF published in English and French.

Part III demonstrates that science fiction has been taken much more seriously in Russian literary circles than has been the case in the U.S., even with the current interest shown by the Modern Language Association. This bibliography of selected criticism in English and Russian is tersely annotated, and I think you will find it more interesting than you would suppose. You may be able to locate some of the English and American articles in university libraries.

Professor Suvin comments on a subject that has brought questions from many readers in the past. There is no "correct" way to convert words in the Cyrillic alphabet into English letters; the two sets of characters stand for largely different sounds. That's why you will find both Efremov—his own choice—and Yefremov, Obruchev and Obroutchev,

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Belayev and Beliaev, Zamyatin and Zamiatine.

The bibliography confirms my suspicion that American readers aren't getting a representative view of good Russian science fiction. The English-language publications of the Soviet's Foreign Language Publishing House and the publisher called Mir have undergone a certain amount of official screening. The New York University anthologies have been bad translations of poor stories. Only Mirra Ginsberg—and Professor Suvin—have given us good translations of good stories. Let's hope they both give us more.

ORN

by Piers Anthony • Nelson Doubleday, Inc. (Science Fiction Book Club), Garden City, N.Y. • 1971 • 247 pp. • $1.49 • Avon Books, N.Y. • No. V2405 • 75¢

This sequel to "Omnivore" isn't as strange a book as that was, but it is one of the best men-and-dinosaurs yarns we have had—and a little more. The credits say that the 1970 serial in *Amazing* was the complete book. The Science Fiction Book Club hardback preceded the Avon paperback, and has a nice—if conventional—dinosaur-fight jacket.

In the earlier book, the three people who prefer to be known by symbolic contractions—Cal the scientist, Veg the vegetarian muscle-man, Aquilon the beautiful artist—explored a strange world where animated fungi had spored an intelligent and deadly race of creatures that look like flying manta rays. They brought several of the mantas back to Earth, and were immediately in trouble with the authorities, who logically enough feared a fungoid takeover.

In this one, the villainously omnivorous Establishment sends the three, and some of the mantas, through a time tunnel or continuum gate or whatever to an alternative Earth which is still in the Paleocene, except for an enclave of Cretaceous dinosaurs—and Orn.

Orn is something our Earth never had, or doesn't know that it had. He is a super-bird, a wingless omnivore like me and thee, who sounds rather like *Diatryma* a few million years ahead of his time. What makes Orn's kind unique is that he has total recall ancestral memory. He literally remembers everything that every bird, reptile, amphibian, fish and protozoan in his family tree ever experienced. Even when conditions change, somewhere back in the files is a memory of something analogous that an ancestor encountered—and solved—centuries or eons before. (If he hadn't survived, the memory wouldn't be transmitted. Pure natural selection.)

The three explorers naturally encounter both Orn and the dinosaurs, but only just before agents from their Earth come in shooting, to make the planet safe for our overflow population. There go the dinosaurs in their hidden valley, burned out by some improved weapon that

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makes napalm look trivial. Because—as the first book pointed out—omnivores are ruthless.

As I said, I like it. The dinosaurs are more believable than any I can recall in any other story, and so is Orn—whose experiences we follow in an alternating continuity, until they all come together. But there's one thing that drives me up the wall every bit as much as that tag "sci fi" that the Literary Elite have picked up from the little monsters. Why, why, why does a Paleocene bird—even on an alternate Earth—have to use Latin contractions to name the creatures of his world, including himself? "Mams" are mammals. "Reps" are reptiles. "Cricks" are crickets. "Piscs" are fish. I am disgusted.

SCIENCE FICTION COMES TO COLLEGE

by Jack Williamson • The Author, Box 761, Portales, New Mexico 88130 • 19 pp. • 50¢

An amazing number of colleges and universities in the United States and Canada are offering courses in science fiction. Most of them are historical and critical surveys which, like any course in American literature, tries to demonstrate SF's place in the field of American and world fiction. A few are "how to"—most notably the workshops held at Pennsylvania's little Clarion State College for the past several years, which in 1971 moved to Tulane University.

A good many of these courses are taught by practicing science-fiction writers who happen also to be on the faculties of the colleges in question. Jack Williamson, who compiled this preliminary list—he may have a longer one by now—has had a course at Eastern New Mexico University since 1964. Gordon Dickson estimates that there are one hundred fifty, and Dr. Thomas Clareson of the College of Wooster, Ohio, editor of "Extrapolation" and mentor/founder of the Science Fiction Research Association, thinks there may be two hundred. "Name" writers you should know, who have courses, include James Gunn at the University of Kansas (he is producing a series of films on SF); "William Tenn" at Penn State (Phillip Klass); Joanna Russ at Cornell; Darko Suvin at McGill (he is the Yugoslavian authority on SF in the socialist countries); and Frederik Pohl at Brookdale College. At the Clarion workshops, writer/professor Robin Scott Wilson has drawn on a team of top writers: Harlan Ellison, Fritz Leiber, Damon Knight, Kate Wilhelm, and others. And I am sure I have skipped newer writers who are active in other magazines.

Each course listing includes a paragraph of summary showing what kind of course it is. You may also be interested in the composite reading lists.

If you know of a SF course in a college near you, ask the instructor to get in touch with Jack Williamson at the address given above. If you teach one yourself, that's an order . . .

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Dear Sir:

Although this may be an unusual request, I would appreciate it if you would give me any help possible. I would be interested in knowing if the staff of Analog knows of any group, organization, or individual who is doing serious work, or study, on the problem of interstellar space travel by means other than the standard rocket propulsion or reaction motor. Your cooperation is greatly appreciated.

THOMAS W. GAGE
270 So. 13th East, Apt 2
Salt Lake City, Utah 84102
How about it, readers?

Dear Sir:

Poul Anderson, in his guest editorial, has raised a number of pertinent questions and stated quite properly that we do not have definite answers to them. The implications are that these are not only suitable but insistent areas for treatment in science fiction and in projections for possible futures.

For one of his questions it can be definitely stated that the only answers lie within two very narrow fields. I do not expect either type of answer to be adopted. And that raises another set of questions with their own complex answers. These are all suitable subjects, also, for our projections.

Poul raised the question of the

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proper prenatal conditions for the development of effectively operating human beings, and the method of providing those conditions in a money-economy like ours. We proclaim ourselves a "humanitarian" society which cares for "unfortunates," yet as Poul points out, we do not fulfill the responsibilities this entails. One solution would be to admit that we are not humanitarian or "do-gooder" and accept the hard-hearted responsibilities that would involve. There has been some discussion of this recently (See "Letters" in *Science* (Dec. 10, 1971) 174: 1077-1078). Obviously we will not abandon our hypocrisies to this extent.

A slightly less unlikely choice, but the only other field of solution, entails dropping our hypocrisy in the other direction. This would involve a straight subsidy for *everyone* at the current "minimum standard of health and decency," making that also the basic exemption for income tax, and putting a steeply graduated tax on *all* other income.

Since neither of these is likely to be adopted, the alternative "field" is clear. It has been expressed as: "The pendulum swings, but the clock moves forward." That is to say, neither kind of solution will be adopted; a trend toward one generates a counter-trend toward the other; but the pendulum swings from side to side; the clock moves toward a radical transformation of the society. This has happened to every civilization which refused to resolve its hypocrisies.

Form of transformation, and methods, are open for suggestions.

CLIFTON AMSBURY
768 Amador Street
Richmond, California 94805

Most of the solutions to vital social problems of the past have been somewhere around the middle of the pendulum's swing. Extreme solutions apparently generate more extreme problems!

Dear Mr. Bova:

In response to your question about "Foundlings Father" and sex in science fiction; The only thing that I found disturbing was the obscene gesture. The rest of the art expressed the idea of the story tastefully.

The sex in Pohl's "The Gold at Starbow's End" disturbed me at first but when it was developed more I was able to accept it as a part of the story. I am more concerned with the explicit sex that is in some of the late science fiction.

More Niven, Schmitz and Pohl.

ROBERT E. MCMASTERS
8709 S. Lawton
Oklahoma City, Oklahoma 73159

Dear Mr. Bova:

The Kelly Freas illustration in the December 1971 issue is merely a study in communication: one nude male figure expresses a nonverbal

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message by raising the central digit of his hand. Another male in Amish dress expresses by facial muscles his understanding of the message. *Thus is communication achieved.*

Furthermore, this one illustration, more than any other ever published in ASF, signifies the attitude toward Dogma and Irrationality that John W. Campbell, Jr., espoused.

ARLAN K. ANDREWS, (Sc.D.)
1608 Efland Drive
Greensboro, N.C.

Dear Sir:

I have been reading Astounding/Analog for a good many years (my own collection goes back to 1953!) and, there has been only one fault I could find with the magazine—what I call the "birds and bees syndrome."

The human characters inhabiting your pages have usually appeared to be singularly lacking in natural instincts and functions, in fact I have sometimes wondered whether they even had navels! Unfortunately, Kelly Freas's drawing for "Foundlings Father" doesn't clear up that point.

However, I thought the illustration was excellent. In the tradition of one picture being worth a thousand words, it was a graphic representation of the *whole* story rather than just one scene.

I fail to see how one could illustrate a story about nudists without showing them in the nude. Of course, they could be pictured behind a bush, but that, like adding a fig leaf, is a sniggling kind of obscenity in itself.

I don't believe that there *is* such a thing as an obscene gesture, since obscenity, like beauty, is in the eye of the beholder. The little old lady in tennis shoes who never heard of giving someone the finger, would find nothing wrong with the gesture. A loss of innocence unaccompanied by the gift of insight and humor is a sad state of affairs.

MOLLY ABLITT
24 Drumlin Road
Westport, Conn. 06880

Dear Mr. Bova:

Concerning the last three letters appearing in the March 1972 B.T.:

The first suggestion that I can make to the three people in question is to have them reread—or read, as the case may be—Jack Wodhams' story "Foundlings Father." Maybe then they would understand how silly their letters are. Mr. Wodhams is poking fun at the extremist attitudes toward sex and morality displayed by both sides. Of course, neither of these societies could survive because they're both oppressive and restrictive. I'll bet that Mr. Campbell had a hearty chuckle when he read the story. And for good reason. This story, like several of Mr. Campbell's Editorials, makes us look at the ri-

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diculous things we get all hung up on when there are more important things we should be doing to help our world.

My second suggestion is for these people to review the reasons for illustrations in a story. Art not only helps us see what the author is telling us—it also should help convey the atmosphere of the story. There is no doubt that Kelly Freas read the story before doing the art work. I grant that the story does not have these three particular scenes spelled out like they are in the illustrations, but that is insignificant. What he has done is capture the farcical situations contained in the story and drawn them as he was inspired to see them. Mr. Freas has drawn the gist of what Jack Wodhams' story says.

Of course Mr. Campbell bought the illustrations as they are presented here; they complement the story perfectly . . .

SPENCER R. LEPLEY
Mobile Home Estates #2
Country Club Road
Valdosta, Georgia 31601

Dear Editor:

As a long-time Analog reader and a bona fide member of the college student, under 21, "now" generation, I also object to the Freas illustration at the beginning of "Foundlings Father." The point seems to me to be that the particular gesture was not called for in the story, or if it was, the illustrator was under no obligation to reproduce it in full page splendor. I do not think Analog owes its readers any apology for what it prints, but I do think the quality of the articles and pictures should speak for themselves, without the puerile addition of objectionable material. You may ask, what is objectionable? Well, I am an intelligent, paid in full subscriber who does find that particular picture objectionable.

MARY-JOYCE MCGINNIS
Atlanta, Georgia

Dear Sir:

Concerning the illustration by Kelly Freas of Jack Wodhams's story, it occurs to me that people tend to exhibit great moral outrage over the most ridiculous things. You get floods of letters, not on important issues—pollution, ecology, et cetera—but on unimportant trivial things. Doesn't it seem to you that it is our priorities that are "perverted"?

KIM L. PETERSON
1600 Campus Road
Occidental College
Los Angeles, California 90041

. . . And so it goes. About a hundred letters received so far re: "Foundlings Father" and they are running better than ten to one in favor of Kelly Freas's illustrations. Obviously, no one wants Analog to become a "moral cemetery." But just as obviously, most people were amused rather than outraged by the story and the art work.

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EDITORIAL

continued from page 7

brained eggheads or coldly ruthless, emotionless makers of monsters.

Scientists are a minority group, and like most minority groups, they're largely hidden from the public's sight. They're tucked away in ghettos—laboratories, campuses, field sites out in the desert, or on Pacific atolls. Before the public can really understand what science can and cannot do, the people must get to see and understand the scientists themselves. See them as human beings. Get to know their work, their aims, their dreams and their fears.

A possible answer to this problem of humanizing scientists comes from the same field in which Graves has made his biggest contribution: the study of mythology.

Joseph Campbell, Professor of Literature at Sarah Lawrence College, has spent a good deal of his life studying mythology and writing books on the subject, such as the four-volume "The Masks of God" and "Hero With a Thousand Faces." He has pointed out that modern man has no real mythology to depend on. The old myths are dead, but no new mythology has been raised to take their place.

And man needs a mythology, he insists, to give a sort of emotional meaning to the world in which we live. A mythology is a kind of codification on an emotional level of man's attitudes toward life, death, and the whole vast, sometimes scarifying universe.

An example. Almost every primitive culture has a Prometheus legend. In our western culture, the Greek version is the one most quoted. Prometheus was a demigod who saw man as a weak, starving, freezing creature, barely surviving among the animals of the fields and woods. Taking pity on man, Prometheus stole fire from the heavens and gave it to man, at the cost of a horrible punishment to himself. But man, with fire, became master of the Earth and even a challenge to the gods.

A typical myth, fantastic in detail, yet absolutely correct in spirit. One of man's early ancestors "discovered" fire about half a million years ago. Most likely, these primitive *Homo erectus* types saw lightning turn shrubbery into flame: hence the legend of the gift from the heavens. Before fire, our primitive ancestors were just another marginal anthropoid. With fire, we've become the dominant species on this planet.

The Prometheus myth "explains" this titantic event in terms that simple people can understand and accept. The myth gives an emotional flavoring to the bald facts.

Much of today's emotion-charged, slightly irrational urge toward astrology and spiritualism is really a groping for a new mythology, a mythology that can explain the modern

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world on an emotional, intuitive level to people who are frightened that they're too small and weak to cope with this universe.

Joseph Campbell's work has shown that there are at least four major functions that any mythology must accomplish.

First: a mythology must induce a feeling of awe and majesty in the people: what science-fictionists call "a sense of wonder."

Second: a mythology must define and uphold a system of the universe, a pattern of self-consistent explanation for the phenomena of the world around us. A modern mythology would have a ready-made system of the universe: the known and continuously-expanding body of knowledge that we call science.

Third: a mythology usually supports the social establishment. For example what we today call ancient Greek mythology apparently originated with the Achaean conquerors of the earlier Mycenaean civilization. Zeus was a barbarian sky god who conquered the local goddesses of the Mycenaean cities. Many a lovely legend was started that way.

Fourth: a mythology serves as a crutch to help the individual member of the society through the emotional crises of life, such as the transition from childhood into adulthood, and the inevitability of death.

It just might be that this beloved thing we call science fiction, when it's at its very best, might serve some of these functions of a new mythology.

Certainly science fiction tries to induce a sense of wonder about the physical universe and man's own interior private universe of the mind. Science fiction depends heavily on known scientific understanding as the basic underpinning of a universal order.

Science fiction doesn't tend to support a given political establishment, but does almost invariably back the social bent of western civilization: that is, the concept that the individual man is worth more than the Organization—whatever it may be—and that nothing is more important than human freedom.

Whether or not science fiction serves to help people through emotional crises is more difficult to tell. It's interesting that science fiction has a large readership among the young, the teen-agers who need to find their own individual place in the universe. And how many of our stories about super-heroes and time travel and interstellar flights are really an attempt to deny the inevitability of death?

Nobody intends to certify science fiction as The New Mythology. That's not the intention of either the writers, or the readers. But the beleaguered scientists who are being chivvied by an unsympathetic, know-nothing public might come and sit around our campfire, at least. Maybe we can help each other.

THE EDITOR

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